This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

ON PEAT

AS A

SUBSTITUTE FOR COAL.

BY

RALPH RICHARDSON,

HONORARY SECRETARY OF THE EDINBURGH GEOLOGICAL SOCIETY.

Price 1*s*. 6*d*.

600081708U

PEAT AS A SUBSTITUTE FOR COAL.

ON PEAT

AS A

SUBSTITUTE FOR COAL

INCLUDING DETAILS OF

I. THE DUBLIN PEAT COMMISSION (ALDERMAN PURDON'S), 1872.
II. CLAYTON'S (LONDON) CONDENSED-PEAT PATENT, 1873.
III. MACCALLUM'S (DUNFERMLINE) COAL-PEAT INVENTION, 1873.
&c., &c.

BY

RALPH RICHARDSON,
WRITER TO THE SIGNET,
HONORARY SECRETARY OF THE EDINBURGH GEOLOGICAL SOCIETY.

BIBLIOTHECA·BODLEIANA·

EDINBURGH:
ADAM AND CHARLES BLACK.
MDCCCLXXIII.

232. e. 257.

TO

ALDERMAN PURDON, OF DUBLIN,

A Tribute

OF SCOTTISH ADMIRATION TO IRISH ENTERPRISE AND PHILANTHROPY;

AND TO

A. J. MUNDELLA, ESQ., M.P.,

A Suggestion

FOR HIS

SELECT COMMITTEE OF THE HOUSE OF COMMONS ON THE
PRESENT DEARNESS AND SCARCITY OF
COAL.

PREFACE.

THE Coal crisis through which our country is at present passing, and the anxiety exhibited by all classes of the community to discover, if possible, some SUBSTITUTE for Coal, was the origin of, and must be my excuse for publishing, the following brief treatise. It contains, in an enlarged and complete form, a paper which I read before the Geological Society of Edinburgh at its meeting on 6th March last, in the Bible Society's Hall, the chair being occupied by one of the Vice-Presidents of the Society, HENRY CADELL, Esq. of Grange, Linlithgowshire, who, besides knowing the Coal Question both practically and theoretically,—possessing Coal-fields, and writing ably on Carboniferous geology,*—had studied the question of PEAT as a Substitute for Coal many years ago, and had always believed that it admitted of solution.

The interest attaching to the meeting, which was largely attended by both ladies and gentlemen, was greatly enhanced by the fact, that two fires of condensed peat were kindled and kept burning in the Hall.

In the one fire, condensed peat made according to Messrs Clayton's process, to be afterwards described, was used; in the other, condensed peat made by Messrs Clayton's patent machinery, but to which coal waste and gas pitch had been added, was burned. This latter substance is the quite recent invention of Mr P. Maccallum, C.E., of Dunfermline, Fifeshire, and it will be found described by him in note R. of the Appendix. Both fires burned admirably, giving great heat and a lively flame, and both were entirely without peat odour. It was the unanimous opinion of the meeting that, submitted to this practical test, condensed peat made by Messrs Clayton's machinery, and with or without Mr Maccallum's modification, is a perfect Substitute for Coal.

---

* On the Geological Features of the Upper Coal Basin of the Firth of Forth. (With three plates.) Transactions Edin. Geol. Soc., vol. ii., Part 1. 1872.

Messrs Clayton sent me, shortly before the meeting, the following analysis of their patent condensed peat by Mr A. Vassard, Ph.D. of Paris, the analytic chemist of the Laboratory and Assay Office, 25 Finsbury Place, London, E.C., dated 27th February 1873—

"ANALYSIS OF MESSRS CLAYTON AND CO.'S PEAT.

Mineral ash	8·75
Water	·28
Combustible and volatile matter	90·97
	100·00
Caloric power	7·60

This peat burns beautifully well; gives a bright and white flame; very little smoke or smell; and gives a cinder that can be blown and put to light again even ten minutes after it has been taken out of the furnace."

I may mention that I received from Messrs Clayton at different times three different specimens of their patent condensed peat. The *first* was a beautifully smooth substance in small cakes, each weighing about 4 oz., and being about two inches long by an inch broad; of the hardness and blackness of jet; agreeable and perfectly clean to the touch; and certainly the most elegant article of fuel I ever saw. This I take to be the acme of perfection arrived at under their process. The *second* specimen was what I should believe to be the more ordinary, as it is a less highly-finished product of their manufacture, being more rugged, and of a brownish rather than black colour, yet quite clean to the touch, and thus a contrast to coal. This second specimen, like the first, was air-dried, the process of drying taking about three weeks. The *third* specimen which I received was interesting as being, unlike the other two, artificially dried in about one week's time. A strong desire having been expressed at our Geological Society's meeting on 13th February last, when I merely exhibited specimens of Clayton's condensed peat, that I should at next meeting, on 6th March, arrange to have a fire of it kindled, I wrote to Messrs Clayton, requesting them to send down within a fortnight a sufficient quantity of it to make a good fire. They replied that all their small store of air-dried condensed peat was gone,—there had been several public tests of it at their works,—but that they would dry some for me upon their steam boiler, and forward it to Edinburgh in time for our meeting. The *third* specimen, then, was the result of this hurried artificial mode of drying,—a method which Messrs Clayton do not contemplate under their system, and of which they do not approve. They sent half a cwt. of this peat for our fire,—all in regularly sized pieces like small brown bricks, each weighing about 7 oz. Unlike the preceding air-dried specimens, however, this artificially-dried sample not only displayed the fibres of the peat, but was marked with several cracks, the effect of the forced drying which it had undergone. In sending it, Messrs Clayton wrote me on 5th March,—"We, however, must beg to remind you of what we told you before sending it, *that it is not dry*, and that, even to produce it in the condition sent to you, we have been compelled to have recourse to most objectionable and hasty means, namely, drying it upon the covering of our steam boiler." Notwithstanding all this, it burned perfectly well at our meeting, and, as I have said, gave general satisfaction.

There can be little doubt that Clayton's, as it is the latest, is also the best process yet discovered for the conversion of peat into a substitute for coal. That process may yet undergo modifications; and our countryman, Mr Maccallum, has already contributed one of considerable advantage in districts where coal-waste is easily found. But, as the Rev. Dr Begg, Mr Milne

Home, Professor Balfour, and others truly pointed out at the meeting, the great and national importance of Messrs Clayton's process consists in this, that it proves that, even if the Coal supply of Britain were to be exhausted to-morrow, we should yet have a substitute left. We should not even then, as Mr John Ball gloomily foreboded in the "Times" of 22d February last, "return to a condition economically similar to that which prevailed before the Norman Conquest." "Coal," said the "Times" in a recent leading article, "is the rock Britannia sits on, and she has lately cared for nothing else. When the pick has gone, the trident will go too, unless we can discover something the eye has not seen or the mind thought of." At the meeting on 6th March we saw plainly enough in the fires then burning that coal is not the only means we possess of enjoying a blazing hearth; and the following pages are devoted to the inquiry how far the mind of man has been successful in devising the preparation and achieving the introduction of PEAT as a Substitute for Coal.

35 CASTLE STREET,
EDINBURGH, *April* 3, 1873.

CONTENTS.

PAGE

Definition of Peat, ... 1
Its various uses, ... 1
  a. As a Soil, ... 1
  b. Illuminating Gas, ... 1
  c. Products of its Distillation, ... 2
  d. Means of Purifying Sewage, ... 2

Question of Duration of our Coal Supply, ... 2
Sudden Rise in Price of Coal, ... 3
Who is to blame for it? 4
How Peat came to be regarded as a possible Substitute for Coal, . 5
Its connection with Coal, ... 6
Different Layers in a Peat Bog, ... 7
The Chemistry of Peat, ... 8
Probable extent of Peat Bogs in United Kingdom, ... 9
Effect of Agriculture on them, ... 10
Effect of Geological Denudation, ... 11
Substitution of Peat for Coal in River Shannon Steamer, . . 12
Continental and American Substitution of Peat, ... 14
"Torbite," or Prepared Peat of Horwich, ... 15
Production of Charcoal from Peat, ... 17
Mr Hahn Danchell's Views, ... 17
Report of Alderman Purdon's Dublin Commission on Peat Fuel,
    Discussing :—
  1. Ordinary Cut Peat, ... 20
  2. Compressed Peat, ... 21
  3. Condensed Peat, ... 22

Clayton's Patent Process of Condensing Peat—in three stages—
  1*st*, Conveyance of the Peat from the Peat Bog—Loose and
    Fixed Water in Peat, and how Extracted, . . 26
  2*d*, Masticating the Peat—Description of Machinery, . . 27
  3*d*, Drying the Peat—Sheds employed, . . . 30

PAGE
Labour and Expense required under Clayton's Process, . . 30

Criticisms on the whole subject—
  1. Drying the Peat, ... 32
  2. Over Mastication of the Peat, ... 34
  3. Stirring of Condensed-Peat Fires, ... 34
  4. Heating Power of Peat, ... 35

Superiority of Peat over Coal in—
  a. Iron Smelting, ... 35
  b. Tile and Brick Burning, ... 35
  c. At Guinness' Brewery, ... 36
  d. Getting up Heat rapidly for Fire-engines, . . . 36

Public Tests of Clayton's Machinery—Opinions thereon of—
  1. "Colliery Guardian," 37
  2. "Iron," 37
  3. Mr Ford North, ... 39
  4. "Times," 39
  5. "Mining Journal," 39

Conclusion, ... 40

APPENDIX.

Note A. Peat Soil preventive of Potato Disease, . . 43
„ B. Mr Mundella, M.P., on the present Coal Famine, . 43
„ C. Effect of the Coal Famine on Commerce and Industry, 44
„ D. Effect of the Coal Famine on the Public Health, . 46
„ E. Peat Charcoal as a Purifier of Sewage, . . . 46
„ F. An Irish Grievance in 1844, ... 47
„ G. Observations by Dublin Commission on Peat generally, and Irish Peat Bogs in particular, . . . 47
„ H. Effect of the Coal Famine on Clyde Steamers, . . 52
„ I. Effect of the Coal Famine on British Iron smelting, . 53
„ J. Opinion of "Times" on Mr Mundella's Motion and the Coal Question, ... 53
„ K. System of Mr Box, C.E., ... 59
„ L. Importance of Peat Charcoal, ... 60
„ M. Irish Compressed Peat Company, ... 61

PAGE
NOTE N. Old Experiments and Inventions connected with Peat of Members of Highland and Agricultural Society of Scotland, ... 62
„ O. Instance of Export of British Coal, ... 64
„ P. Mr Ford North's Views on the Improvement of Peat Fuel, ... 65
„ Q. Major Graham, of Meiklewood, on the Removal of Peat Moss, ... 66
„ R. Mr Maccallum, C.E., on Coal Peat as Fuel, . . 67
„ S. Proposed Joint-Stock Peat Companies, and Estimated Cost of Working, ... 72
„ T. Coal Used in Iron smelting, ... 75

ON

PEAT AS A SUBSTITUTE FOR COAL.

PEAT is, to use the definition of our former respected President, Dr (now Professor) Page, " a product of cold or temperate regions, and arises chiefly from the annual growth and decay of marsh plants—reeds, rushes, equisetums, grasses, sphagnums, confervæ, and the like being the main contributors to the mass, which, in process of time, becomes crowned and augmented by the presence of heath and other shrubby vegetation."* In this country, peat is one of the most common and uninteresting of objects; yet, like many similar works of nature, it is capable of application to many and important uses. As a soil, it is of itself too rich; but when drained and limed, it is of the best quality; indeed, for some kinds of plants (rhododendrons, &c.), it is invaluable.† Peat has also been found to yield an illuminating gas, the power of which is not very high, but yet may perhaps be capable of being increased. A village at Westmeath was lighted with peat gas.* As a subject of distillation, again, peat is of importance—tar, naphtha, ammonia, acetic acid, pyroxilic acid, oils, and paraffin being yielded, as shown in the International Exhibition of 1851.† But this does not exhaust the capabilities of our apparently commonplace subject, for Mr Hahn Danchell of Horwich, Lancashire, maintains that peat-charcoal furnishes one of the best means of purifying sewage which exists, and strongly urges its introduction into general use, as at once cheaply procurable, easily managed, and certain in result.‡ Yet it is not to any of these uses of peat that I would refer on the present occasion. I would confine myself to the consideration of peat as a Substitute for Coal; in other words, to the capabilities of peat as a general source of fuel.

---

* Advanced Text-Book of Geology, p. 351. A series of " Essays on the Natural History and Origin of Peat Moss. By the Rev. R. Rennie, Kilsyth," was published at Edinburgh in 1807.

† See Note A.

The question of our Coal Supply used to engage public attention and perplex geologists. That question is now so far settled, the belief being apparently well grounded that we have an abundant supply of the precious deposit sufficient to last for many years to come. Sir William Armstrong, the distinguished President of the North of England Institute of Mining and Mechanical Engineers, in delivering, on 1st February last, the Inaugural Address, stated that, assuming coal could be worked at a depth of 4000 feet, then 146,480 millions of tons were yet available, which, at the present rate of consumption, would last 1273 years; but increasing at the rate it had done for the last fifteen years, it would be exhausted in 110 years. "The truth," he said, "probably lay between these two extremes."*

---

* English Cyclopædia. Peat is used in Italy as fuel for gas-furnaces.

† Encyclopædia Britannica.

‡ Concerning Sewage and its Economic Disposal. By F. H. Danchell, C.E., 1872.

Professor Ramsay, again, an eminent Honorary Fellow of our Society, and Director General of the Geological Surveys of the United Kingdom, states that, whilst himself offering no positive opinion on the subject, he suspects that the view adopted by Mr Hunt, of the "Mining Record" Office, that our coal supply will probably last for about 1273 years, is likely to be nearer the truth than computations of so alarming a character as that of the Report of the Coal Commissioners, that 276 years mark the probable duration of the supply.† At all events, at the present moment, and regardless of the wants of a distant posterity, we know that there is a great supply of coal in Britain, and moreover that that supply will last all our time. The question now-a-days, however, is not so much as to the *duration* of the supply of coal, but as to its being excavated and made generally available. It has been found that the price of coal has of late risen so rapidly, that the article has become quite a luxury, and almost beyond the reach of any but the wealthier classes. And the rise in price has been as sudden and unexpected as it has been great. To take as an instance a place out of the influence of city prices, I find that at Newpark Railway Station, fourteen miles west of Edinburgh, a ton of the best Benhar coal sold in August 1871, at 9s.; in February 1872, it had advanced to 12s. 6d.; in August 1872, to 17s. 6d.; and in December 1872, to 23s.; making a total advance of 14s. per ton, or more than 150 per cent. in less than sixteen months. I may add, that I understand the last dividend paid to the shareholders of the Benhar Coal Company was at the rate of 27½ per cent. Now, as we are all aware, coal is an article which enters so largely into manufactures, that anything affecting it injures, if it does not paralyse, the whole industries of the country.* To this must be added the serious effect of the want of coal upon the health and comfort of the people.†

---

* See Note B.

† Physical Geology and Geography of Great Britain, 1872, p. 307.

I am not going into the question of *who* is to blame for the sudden and enormous rise in the price of coal which has recently taken place. I would only say, that I do not think the coal-masters should be wholly exculpated, or that the miners should be wholly blamed. I believe that, whilst, on the one hand, the miners have certainly by *strikes* been the means of raising the price of labour; yet that, on the other hand, the masters or coal-merchants (I know not which) have increased the price of coals to the public out of proportion to the rise in wages granted to their men; their only excuse being that, having had a series of bad or unprofitable years, they are now attempting to make the most they can out of a good one. We must all trust sincerely to see the matter right itself some day, and look forward to some understanding being come to between masters, miners, merchants, and the public, whereby the last may be enabled to obtain at a reasonable rate an article so precious and so essential as coal.

---

* See Note C. † See Note D.

But when is this happy consummation to take place? Must not the most sanguine acknowledge that it may possibly be long ere prices return to their old quotation? I presume that, if they did, the question now so common, Is there, then, no Substitute for Coal? would not be put, at least by no means so anxiously. In the face, however, of the present famine prices, and with the probability of their continuance for no one knows how long, full in view, the question has been pressed upon the nation with an earnestness which admits of no trifling.* And it at once found an answer. It was replied, that PEAT was a substitute for coal. Not, of course, peat as newly dug from the bog—wet, soft, and bulky; but peat after due preparation, and which had been made dry and hard, and had been compressed into space sufficiently small to enable it to be conveyed easily and cheaply. I propose to examine to-night this suggested substitute for coal, and to state as far as I know whether and by what processes peat has been converted into an article of commerce suitable for general use, and worthy to compete with coal as a source of heat and means of fuel.

---

* As Professor Page, of the College of Physical Science, Newcastle-upon-Tyne, wrote me on 7th March, after referring to some old inventions for improving peat fuel:—"What was not worth while carrying out when coals were at 9s. a ton may be profitable now that they are selling at 30s." Even Newcastle is hard-up for coals!

It may perhaps be well at first to explain how prepared peat at once occurred to thoughtful minds as a probable substitute for coal. It was not alone the common use of peat in Highland and remote districts, where each peat bog serves as a superficial coal-field for the surrounding neighbourhood. It was the fact that this peat bog is a coal-field in embryo—that peat is coal in a soft, half-formed state, just as shale was once mud, and sandstone loose sand. "You may see," said that wonderfully graphic geological writer Canon Charles Kingsley very recently, "every gradation between coal and the growing forest. You may see the forest growing in its bed of vegetable mould; you may see the forest dead and converted into peat, with stems and roots in it; that again, into sunken forests, like those to be seen below high-water mark on many coasts of this island. You find gradations between them and beds of lignite or wood coal,* then gradations between lignite and common or bituminous coal, and then gradations between common coal and culm or anthracite, such as is found in South Wales. Have you not a right to say, 'These are all but varieties of the same kind of thing, namely, vegetable matter? They have a common origin, namely, woody fibre. And coal, or rather culm, is the last link in a series of transformations from growing vegetation.'"† And as Mr James

---

* I have heard Professor Geikie, F.R.S., the President of our Society, mention that whilst the peat at the bottom of a peat moss is generally very compact, he had seen peat in the Island of Skye which resembled lignite, and took a polish.

† Town Geology, 1872, p. 124.

Geikie remarked, in his able paper on "Buried Forests and Peat Mosses,"* "The best peats are 'cast' towards the bottom of a peat moss. They show a somewhat close and compact texture, so much so as occasionally to resemble coal." "The quality of peat," said Mr Henry Anderson, in a paper read before our Highland Society, to be afterwards referred to (p. 35), "naturally varies considerably in almost every district." He mentions that in general the uppermost portion, termed "flow," varies from one to ten feet in depth, and has but little heating power, being light and open. Beneath this "flow" is a much closer and denser substance, forming fuel of sound quality, producing a good flame, and yielding a large amount of heat. The ash of this peat, as also of the flow, is white. The lowest stratum of the peat is "still closer and denser, approaching much nearer coal, becoming hard, black, and weighty," when dried and stacked, and affording a greater amount of heat. This is preferred for fuel to the two upper layers, and its ash is red, "arising from its closer proximity to the clay." The pressure of the upper layers of a peat bog must serve of itself to make the lower layers more dense and valuable for fuel. But there is another consideration, viz., that the lower the layer the less is it exposed to the influence of the atmosphere.† Bituminous coal (not anthracite or cannel) is believed to depreciate as a fuel by exposure, and it has even been asserted that very rich coals may, after nine months' exposure, lose half their value as combustibles.

---

* Read before the Royal Society of Edinburgh in 1866. (Transactions, vol. xxiv. p. 363.)

† For the influence of the atmosphere in actually removing the peat formation, see Mr James Geikie's remarks, p. 11.

Wood or woody fibre, then, is the origin and substance of both peat and coal. This woody fibre is a compound of carbon, hydrogen, and oxygen; and it is in the act of the constituents of this fibre combining with the oxygen of the air at a high temperature, that heat is generated. But peat contains water to a much greater extent than coal, and this water is of course opposed to combustion, and must be removed. It has been found that peat, when pressed, lost sometimes more than one-fourth of its weight of water. Again, peat is loose and bulky, whilst coal is firm, and easily transported. Common peat also, when burned, produces a great quantity of ash, causing not only much dust, but occasionally in smelting processes a chemical action of an objectionable nature.* Such ash may sometimes amount to one-third of the weight of the peat, and is due to the non-combustible earthy matter it contains, and which is likewise present to a much greater extent than in coal. To close for the present this list of serious objections to peat as a fuel for general use, I may just mention the unpleasant odour it occasions when burned, a peculiarity with which we are all so familiar in our Highland rambles.† This odour arises, no doubt, from the moist character of the unmanufactured peat used, added perhaps to the half decayed and not wholly transformed state of the vegetable matter of which it is composed. Previous to considering what methods have been employed to overcome the obstacles just cited to the introduction of peat as a substitute for coal, it will be well to inquire to what extent it exists in our country.

---

* See Note L.

† I believe this is not an unmixed evil, for I am told that it will drive bugs from a house,—an important hint to householders in despair.

I need hardly state that it exists to a very great extent indeed. As to the probable amount in Great Britain and Ireland, Mr Hahn Danchell has estimated it at six millions of acres,* each acre of peat bog being in his opinion capable of yielding, on the lowest computation, 1000 tons of charcoal.† "In the Highlands and Islands of Scotland," wrote the "Oban Times" recently, "there are hundreds of thousands of acres covered with peat moss which, if properly utilised, would serve the country both for domestic use and manufacturing purposes for centuries. Hitherto these tracts of peat moss have been all but useless to the country, and of little or no value to their proprietors." "The outer Hebrides," said the London "Morning Post" also quite recently, "abound in enormous quantities of the finest deep black turf, which if properly manufactured, could be shipped from Stornoway, Loch Maddy, Loch Boisdale, and other harbours. It is said that Sir James Mathieson alone has 300,000 acres of peat in the Lewis" (equal, according to Mr Danchell, to 300,000,000 tons of charcoal), "the other great Highland and island proprietors" (such as the public spirited Duke of Sutherland) "having enormous districts of it." But Ireland—"poor old Ireland," as Charles Kingsley somewhere pathetically calls it—seems the richest possessor of a deposit hitherto only deemed a proof of the poverty of the country. So long ago as 1844 Dr (afterwards Sir) Robert Kane, Secretary to the Council of the Royal Irish Academy, in his treatise on "The Industrial Resources of Ireland,"* estimated the total area of Ireland at 20,000,000 acres, and the total area of peat bog at 2,830,000 acres, or nearly one-seventh of the entire surface of the island. Of these bogs, he said, there were 1,576,000 acres of "flat bog," that is, spread over the plains, the remaining 1,254,000 acres being "mountain bog."†

---

* "Concerning Sewage," 1872. This is corroborated by the journal "Iron" of 8th February 1873, whilst the "Colliery Guardian" of 7th February gives the same figures for Great Britain alone.

† See Note E.

It is evident, therefore, that there is no lack of peat in the United Kingdom, indeed, in so far as it is mere unprofitable and waste land, there is a very great deal too much. Slowly, it is true, but only very slowly, the vast tracts of peat bog are decreasing. Civilisation and agriculture are nibbling at their borders, and many a fine green sward was but a few years ago a dark and filthy moss.‡ I remember not so long since seeing the policy grounds of Benmore, near Kilmun, on the Clyde, (then the property of Mr Patrick) being converted from a wilderness of peat into a beautiful lawn by the simple process of draining, delving, and liming.* But not only is civilisation at work upon our peat bogs, Geological denudation is silently but steadily affecting them too. As Mr James Geikie pointed out in his paper on the "Buried Forests and Peat Mosses of Scotland," already referred to, "A glance at the present aspect of our peat mosses will convince any geologist that this formation has not only ceased to spread, but is in most cases rapidly disappearing.† . . . . . The peat of a hill top usually shows a most ragged and wasted aspect. . . . . . The peat is dead, and, like the upraised coral reefs of the South Seas, wears rapidly away at the touch of the atmospheric agents. . . . . . The peat mosses of Scotland are thus only a wreck of what they have once been." Any one crossing one of our mountain moors, say, for example, the lonely morass from Loch Skene to above the Loch of the Lowes, must

---

* See Note F.

† Dr Kane uses the Irish term "turf" (German *torf*) for "peat." "Peat" is derived from the Icelandic *pittr*, a pool, or from the German *pfütze*, a bog or slough. For Observations on peat generally, and the Irish peat bogs in particular, see note G.

‡ Sir Humphry Davy said, that "a soil covered with peat, is a soil covered with manure." Mr Milne Home stated at our meeting on 6th March, that the removal of peat is most beneficial and desirable from an agricultural point of view, as a fine virgin soil will generally be disclosed

---

beneath it. "And thus," as the Rev. Dr Begg (whose advocacy of the Peat question is not the least of his many philanthropic public acts) remarked at the same meeting, "we shall kill two birds with one stone. We shall first, by Clayton's, or some other process, find in peat a valuable substitute for coal, and we shall next find beneath the peat we have thus removed a new soil to form a permanent agricultural benefit to the district." Considering such subsequent agricultural benefits, it would not be too much to expect proprietors to give peat bogs for nothing for conversion into fuel, and consequently for clearance.

* See Note Q.

† This is corroborated by Professor Geikie, Director of the Geological Survey of Scotland, in his new edition of the well-known "Manual of Geology," by the late Mr Beete Jukes, Director of the Geological Survey of Ireland, 1872, p. 739.

have noticed the enormous holes which, not the spade of man, but of Time has cut in the peat—holes so wide and so frequent that none but a young and athletic traveller, who partakes of the agility of the " bold yeoman's " nag,

> " That through a bog, from hag to hag,
> Could bound like any Billhope stag,"*

should attempt the journey. But notwithstanding all this, there is a vast extent of our country still lying under peat; and there can be little doubt that these, our surface coal-fields, will last long years after those subterranean ones, whose duration has been of late so questioned and limited, have ceased to furnish fuel to all nations.†

To turn now to the attempts which have been made at various times to employ peat as a means of fuel in competition with coal, I may begin by citing its employment in 1843 in working one of the Dublin Steam Packet Company's boats plying up the river Shannon from Limerick. The peat used was plain and unmanufactured, and the result arrived at was " that turf (or peat) may be used advantageously in localities where it abounds, and where there is an absence of coal."‡ The Lords of the Admiralty hearing of the success of the experiment, and having received a proposal to cut peat at the Falkland Islands for the service of such of

---

* " Lay of the Last Minstrel," canto iv. " Hag " (derived from verb *to hack*) is the Scotch term for a large hole in a peat bog.

† See Note O.

‡ Kane's " Industrial Resources of Ireland," p. 55.

H.M. steam vessels as might proceed to the Pacific, directed their secretary, Mr Sidney Herbert (afterwards Secretary at War, and created Lord Herbert of Lea), to communicate with the secretary of the Dublin Steam Packet Company regarding the Shannon steamer.* He did so, and in a letter in reply, dated 21st July 1843, the Steam Packet Company's secretary (Mr C. W. Williams) stated the following particulars:—

“1. The ‘Lansdowne,’ a steamer with two engines, 38½ inch cylinders, at 3 feet 6 inches stroke, consumed upon an average 120 tons of coal per month, running daily (except Sunday) a distance of 46 miles, at 18s. per ton, covering expenses, . .	£108	0	0
“The same duty is done with 1419 boxes of turf (or common peat), of 20 cubic feet, about 250 tons weight, at 7d. per box, ...	41	7	9
“Difference in the cost of fuel per month,	£66	12	3

“2. The difference in weight is, therefore, as two of peat to one of coal, and on the Shannon the difference in price is less than one-half that of coal.

“3. Its proportionate duration may be estimated by the quantity required, compared with coal, to perform the same duty, that, being double its weight, its duration in the furnace is half that of coal.”†

Mr Williams added that, from experiments made with peat in an experimental boiler, it was found that peat could only be profitably used when it was of the quality that is obtained in good seasons; and that if bad or damp, its evaporative power was reduced one-third and more.

---

* See Note H.

† Kane's “Industrial Resources of Ireland,” p. 54.

Turning to the Continent, we find that at the present day in Sweden, Bavaria, Wurtemberg, and Bohemia, iron of the finest quality is made with peat, more or less condensed, alone. Indeed, as we were informed by our chairman (Mr Cadell) at last meeting, peat is *preferable* to coal in the smelting of iron ;* and he mentioned that it was no uncommon thing for scraps of old Scotch iron to be shipped to Sweden, and there undergoing smelting by means of peat, to be returned to us under the name of fine Swedish iron.† In North America, again, various lines of railway use manufactured peat instead of coal. Seven hundred tons of this peat are said to be daily used by the Grand Trunk Railway, all furnished by the bog factories near Montreal, at 9s. to 10s. per ton, whilst coal would cost 40s. per ton. "On a train running 177 miles, the coal expenditure was £6, wood £6, 3s., and peat-coal only £1, 10s."‡ Peat, both common and compressed, is in general use on the state railways of Bavaria.§ Especially, therefore, where our railways run (as nearly all the Scotch and Irish do) through or near peat bogs, ought this question of peat *versus* coal to be seriously considered by their directors and shareholders. The only reason why peat should not be used for railway locomotives here as in America and Bavaria, is the humid state of our atmosphere and the difficulty of drying the peat; but all years are not so wet as last, and it is to be hoped some reliable system of drying within a reasonable time may yet be arrived at, if indeed it is not already known, and only awaits trial.

---

* See old Highland practice referred to in Note L.

† See Notes I and T.

‡ Morning Post, December 1872.

§ Report of Dublin Commission (Alderman Purdon's) on Improved Peat Fuel. Dublin, 1873, pp. 9 and 30.

I have spoken more immediately of the use even of common unmanufactured peat, cut from the moor and dried, as a substitute, in certain cases, for coal. The officials of the North British Railway are, I understand, at present experimenting upon the appliance of such peat to their locomotives during the present coal famine. But, for peat ever to compete thoroughly and successfully with coal, it must be subjected to a more complicated process. Various ones have been suggested, and I shall have occasion to refer to several, both at home and abroad. But I must first briefly allude to one which was heralded the other day by a correspondent of the London "Morning Post;" which on its authority went the round of the provincial papers; and the statements in which I find, on inquiry, to be so incorrect that I feel it my duty to the public to undeceive them.

The process to which I refer was that said to be employed at Horwich, in Lancashire, where was made what was called "torbite," or prepared peat. It was stated in the "Morning Post" that this "torbite" was tested in competition with Lancashire coal,—the result being, that whilst the coal "got up steam to 10 lb.

pressure in 2 hours and 25 minutes, and to 25 lb. in 3 hours," the torbite got it up "in 1 hour 10 minutes to 10 lb., and in 1 hour 32 minutes to 25 lb.,—21 cwt. coal keeping up steam at 30 lb. pressure for 9 1·3 hours, 11¼ cwt. torbite or peat fuel for 8 hours at the same pressure." * I wrote to Mr Hahn Danchell, who is managing director of the "Peat Engineering and Sewage Filtration Company, Limited," Red Moss Works, Horwich, for corroboration of these startling statements. He replied on 22d January 1873 (that is, a month after they had appeared in the "Morning Post") as follows:—"The Condensed Peat Company, who originally owned these Red Moss Works, attempted some years ago to manufacture a condensed peat, which they called torbite. Owing to mismanagement of their affairs they were obliged to give it up, and two years ago it came into the hands of the present company, the Peat Engineering and Sewage Filtration Company, after having stood vacant for about four years." The impression left on the mind on reading the letter in the "Morning Post," was that the torbite works were actually at present in operation. They have long ceased to exist, and as to their success Mr Danchell continues:—"The statements of the wonderful excellence of the peat-fuel are certainly incorrect, and where the "Post" can have got them from I do not understand. The best peat does not contain more than 50 per cent. carbon when compared with that of coal, and it is obvious, therefore, that it cannot yield double the

---

* Morning Post, December 1872.

amount of heat. Peat may be very useful as fuel for many purposes, but the heat it yields as compared with coal is as one to two, taking the weight of both—that is, coal two and peat one." Mr Danchell then adverts to a process advocated by a Mr Box, C.E.,* in a pamphlet referred to in the same letter in the "Morning Post." He observes—"I should be sorry if any one should be induced to follow out his advice of treating peat. I have saved one gentleman from serious losses, Ford North, Esq., Glemham Lodge, Lower Norwood, London" (who will be afterwards referred to), "who was on the point of buying an extensive bog in Ireland, with the view of working it according to a plan proposed by Mr Box. He solicited my advice before he had gone too far, and I had ample opportunity to convince him of Mr Box's wrong statements."† In a previous letter on 15th January, Mr Danchell expressed himself as follows regarding Peat as a Substitute for Coal:—"The treatment of peat presents very serious difficulties, particularly in this country, owing to the moist climate. The drying in open air meets with many obstacles, and that of drying under cover or by artificial means has not as yet received sufficient attention on the part of engineers to warrant extensive undertakings in this direction. But I venture to express my opinion, that it will at all times be a difficult matter to produce peat for fuel at a sufficiently low price to compete with coal, except when the peat is intended for consumption on the spot; but it is different when it is the intention to produce *charcoal* from peat. Here, I believe, is an unlimited field for enterprise and for great profits.* The following estimate may help to illustrate and bear out my opinion:—

---

* See note K.

† See note P.

"The cost of producing one ton of peat-charcoal may at an average be stated to be 15s., and the price at which it will find a ready sale is 40s. The cost of producing one ton of dry peat may be taken at an average to be about 2s. 6d., and the average price at which it may be sold 4s. Now, four tons † of peat will yield one ton of charcoal (some kinds of peat will yield more), and the cost of charring this quantity will be at most 5s.; consequently, the four tons of peat in the shape of *charcoal* will yield—

4 × 2s. 6d. × 5s, = 15s. from 40s. = 25s. profit.

The four tons of peat in their *raw* state will yield—

4 × 2s. 6d. = 10s. from 4 tons × 4s. = 6s. profit."

I am sure we are all very much obliged to Mr Hahn Danchell for furnishing, for the information of our Society, such interesting and valuable details; and I would point out that in three leading particulars his views are corroborated by authorities such as Sir Robert Kane, already cited, and the recent Dublin Commission (Alderman Purdon's) on Improved Peat-fuel, to be afterwards referred to:—

1*st*, That the heating-power of peat is, weight for weight, about half that of coal; and, therefore, that the weight of the peat used requires to be double that of coal to compete with coal.

---

* See note L.

† Dr. Percy ("Metallurgy, vol. on Fuel, &c.,") states that Sir Robert Kane informed him that *three* tons would suffice.

2*d*, That under the humid atmosphere of the United Kingdom (unlike that of America and the Continent), the grand difficulty is the expeditious and economical, and certain drying of the peat.

3*d*, That it is doubtful whether peat can be produced for fuel at a sufficiently low price to compete with coal, except when the peat is intended for consumption on the spot.

It will be remembered that Mr Williams, in his report to the Admiralty, distinctly stated that peat "may be used advantageously," not in all cases, but "in localities where it abounds, and where there is an absence of coal." But, Gentlemen, you will perhaps be willing to concede that peat *does* sufficiently "abound" in Scotland to make the introduction of peat at least worth trying. At all events, you can have no difficulty in meeting the second condition for the success of the introduction of peat, for we must all admit that there is at present a sad "absence of coal."

I proceed now to look at the more modern aspects of the peat question in the United Kingdon, for you will, I think, agree that the "torbite" of Horwich, extolled in the "Morning Post," was certainly antiquated, if not actually mythical. As I mentioned before, the great peat bogs of Ireland early attracted the attention of economists. It was to learn how to utilise the vast stores of this Irish peat in the best way, that a patriotic enterprise was headed in the autumn of last year by Alderman Purdon of Dublin, who, with several practical gentlemen, visited the leading peat-works abroad. I am now in a position to give the latest information on the subject, from having received from my friend, Mr Vokes Mackey of Dublin, a copy of the report (published a fortnight ago) of Alderman Purdon's commission on peat-fuel. The price of coal in Ireland having advanced 100 per cent. in the summer of 1872, and the continued rains of last summer and winter threatening a dearth of peat in Ireland, Alderman Purdon undertook at his own expense to organise a "commission for the purpose of investigatating, in the public interests, by personal examination in the fullest manner, such of the best modern systems of preparing improved fuel from peat as are now to be found elsewhere."* The commission—consisting of Alderman Purdon; Mr Alexander M'Donnell, locomotive engineer, Great Southern and Western Railway, M.I.C.E.; Mr J. M'C. Meadows, mining engineer; Mr H. U. Townshend, civil engineer; and as secretary, Mr A. Cerf, professor of modern languages—left Ireland early in last September, visited several of the great peat districts of Europe, and returned in the middle of October. We see thus, that once at least in the history of their distracted country, the Irish exhibited a practical spirit, and performed unaided a useful work worthy of the imitation of their brethren in Scotland.

The report of the commission discusses in order the three methods at present in use for making fuel from peat. The *first* of these is Ordinary cut peat, being that commonly used in peat-producing districts. The commission remark (Appendix C) that except in a very dry season, this is at best a precarious fuel; it varies in form, size, and quality, and is rarely sufficiently dried; and even when it feels dry, it contains a variable percentage of water, and some of its heating power is consumed in evaporating the moisture thus retained. They point out, however (p. 6), that at the Government works at Haspelmoor, in Bavaria, considerable quantities of ordinary cut peat (generally less than two inches in thickness) are annually used as fuel in the locomotives of the State railways. The officials of these railways (p. 30) have no artificial way of drying the peat; it is brought in air-dried. The commission strongly recommend that, "with a climate so moist, and seasons so uncertain as those of Ireland, some reduction" should be made in the thickness of some of the peat cut there, so that, instead of taking eight weeks of average weather to dry, they may become dry in six or so.

---

* Report of Commission for Investigation of Improved Peat-Fuel Manufacture, 1872. Dublin, 1873.

The *second* kind of peat considered by the commission is Compressed peat, produced by mechanical force. The works which they visited where this peat was made were Haspelmoor and Kolbermoor, in Bavaria, where a system known as "Exter's" is followed. The peat is obtained from the surface of a bog (previously well drained and levelled) in the condition of a fine mould or powder, which, when partially dried by exposure to the sun and air (in fine weather, a couple of hours suffice, p. 31), is scraped together in thin layers and removed to the place of manufacture, where, being dried more fully by artificial heat, it is subjected to powerful mechanical compression effected by steam machinery. The peat works have been carried on at the expense of the State for the use of the locomotives upon the State railways. The system is essentially the same as that followed in 1860 at Derrylea, in Ireland, where the results were commercially unsuccessful.* Compressed peat is made in Bavaria, at about 12s. per ton, but the commission do not find in the system such advantages as would justify their recommending it, or any modification of it, for imitation or adoption in Ireland.† Indeed, the Bavarians themselves are beginning to consider whether it ought not to be discontinued, necessitating as it does a "large original outlay upon fixed erections and machinery of a powerful class, with its attendant liabilities to accident." As to the efforts which have been made from time to time for depriving raw peat of the water it contains by means of hydraulic or other mechanical pressure, the commission state that all such attempts have been entirely unsuccessful.

The commission consider next the *third* and last mode of utilising and improving peat fuel. By it is produced what they term "dense" or condensed peat, under which they include every description of peat fuel "resulting from the kneading or mixing, or from the maceration or tearing of raw peat, whether effected more or less perfectly, and which, in this macerated or mixed condition, is subsequently dried in pieces." By this process it is found that peat—

---

* See note M.

† See Mr Clayton's opinion, note N.

1. Dries more rapidly,—a most important consideration;

2. Acquires greater cohesion and density than any ordinary mechanical pressure could impart to it; and,

3. Is consequently more readily transported, and made commercially available.

In connection with this subject of condensed peat, the commission pass under review the systems pursued in—1*st*, The Netherlands, the manufacturing cost there being about 10s. 6d. per ton at the works (Rahder's process). The commission remark, that the annual production of condensed peat in the Netherlands supplies largely the place of coal for many industrial purposes*, and presents the most extensive development of Condensed-peat industry at present in Europe; 2*d*, Prussia, the cost being 6s. 6d. per ton (Schlickeysen's process); 3*d*, Bohemia, the cost being 6s. 9d. per ton, and the process that pursued at the peat-works of Prince Schwartzenberg, probably the largest at present in Europe; 4*th*, Bavaria (Eichorn's process); 5*th*, France, the cost being about 6s. per ton (processes of M. Colart, Valley of the Somme, and M. Bocquet, Valley of the Ourcq); and, 6*th*, The works (already alluded to) of Mr Danchell's "Peat Engineering and Sewage Filtration Company" at Horwich, near Bolton,

---

* Judging by the smell (not unpleasant) of burnt peat in the streets of Amsterdam and Rotterdam, I should think it is also largely used for household purposes.

Lancashire, the manufacture here consisting "almost entirely of a mixture of peat with clay, for conversion into charcoal for sewage purposes."* The commission conclude an able and exhaustive and most praiseworthy report by recommending, "as the system best adapted to the climate and circumstances of Ireland, for the production of improved fuel from peat, *the maceration or pulping of the peat, and its subsequent drying under cover.*" This is the result of the labours of Alderman Purdon's commission, and it applies not only to Ireland, but to the United Kingdom at large.

I have now given you the opinion arrived at, after due consideration, by evidently very practical and trustworthy men. I would, in the next place, describe a system which was unknown to them at the time of their inquiries;† which is based upon the same conclusion at which they arrived; which has only within this new year of 1873 been brought before the public; and to consider and discuss which, as well as to see the first fire of it ever kindled in Scotland, you are met here to-night. I refer to the system by which is produced Clayton's Patent Condensed Peat.

So long ago as 1835, Mr Henry Clayton, the senior partner of the eminent engineering firm of Henry Clayton, Son, and Howlett, Atlas Works, Woodfield Road, Harrow Road, London, W. (near the Westbourne

---

* The commission mention (p. 43) that this mixture, under "Danchell's patent," is to be used in the deodorisation of the sewage of Paris at the Company's extensive works at Bondy, near that city.

† Alderman Purdon wrote me on 5th March last—"Clayton's machine had not been finished when the commission's report was made."

Park Station of the Metropolitan Railway), began to study the question of how peat could best be converted into a substitute for coal. For thirty-seven long years he has grappled with the problem ; and it is interesting to us Scotchmen to know that what first set him a-thinking were the experiments of Lord Willoughby d'Eresby, undertaken under the auspices of our Highland and Agricultural Society in 1835.* Mr Clayton, after thirty-seven years' study, thinks he has mastered the difficulty, and has taken out a patent. Not that he is the first to do so by any means. More than a hundred patents for the improvement of peat fuel † have been taken out at various times, enriching the revenues of the Patent Office, but too often impoverishing the patentees and those who attempted to work their patents practically. In truth, as the "Times" of 13th February last, in describing Clayton's new process, remarked, this subject of "the conversion of raw peat—that is, peat freshly dug from the bog—into a useful calorific agent at a cheap cost, has for many years formed a fascinating subject of study both to the inventor and to the practical machinist." It will be high honour, therefore, to Mr Clayton if he has succeeded in solving a problem which has engaged unsuccessfully so many ingenious minds.

In considering the special question of Clayton's Patent Condensed Peat Fuel to-night, I shall first endeavour to explain the process and machinery by which it is manufactured; and in doing so I may premise that it is not in its leading features, but in its excellence in detail, that this process can claim superiority over others. As Dr Percy points out in his "Metallurgy,"* a process for condensing peat was patented by Linning so long ago as 1837; † and on reading its specification, quoted by Dr Percy, I find that in its leading principles it is very similar to Clayton's. As we are all aware, however, mechanics, like the world, are governed by details. The idea of the application of steam power was long floating in men's minds ere Watt arose, but it was our great countryman who first caught and chained for ever the giant.

---

* See note N.

† "Colliery Guardian," 7th February 1873.

Mr Clayton's process may be conveniently divided into three successive stages—viz., 1*st*, the conveyance; 2*d*, the masticating; and 3*d*, the drying, of the peat. The *first* stage, the conveyance of the peat from the peat bog, is effected by means of patent "squeezing" trucks, into which the raw peat is filled as dug, a piston forced against the peat in the truck by the aid of a screw and lever effecting such a pressure upon the body of the peat as to squeeze most of the "loose or free" water out of it. "Peat in its native condition, or as dug, contains from 60 to 75 per cent. of water; of this only a small portion is "loose or free water," which can be easily extracted by means of draining or squeezing; the great bulk of the water, however, is "locked up," confined in the rooty or fibrous portion of the peat, and cannot be got rid of by the above simple means, nor indeed by pressure, however powerful, while the peat remains in its natural condition. So retentive is the peat of this *fixed* water, that, as ordinarily made up for fuel, it will be found, even after some months of drying, to still contain from 15 to 25 per cent. of water."* The objects, therefore, aimed at by Clayton's process are—1*stly*, to get rid of as much water as possible by drainage and squeezing; 2*dly*, to thoroughly cut up the fibrous or rooty portion of the peat, releasing the great quantity of water and air which was previously fast in the fibre; and, 3*dly*, to reduce the whole to an uniform state of pulp.

---

* Volume on "Fuel, &c.," 1861, p. 77.

† Mr Slight, Curator of our Highland and Agricultural Society's Museum, made the experiments for Mr Linning. See the Society's Prize Essays and Transactions, Vol. IV., New Series, 1835, p. 115, cited in Note N.

"Peat thus prepared (by this threefold process) will freely part with the whole of its moisture by evaporation, will dry rapidly, and in doing so will consolidate itself, and naturally acquire a density (*which no pressure of the peat in its natural state could produce*), becoming as compact and hard as oak, and of a specific gravity nearly equal to coal. In this state it is (unlike the common prepared peat) as non-absorbent of water as coal itself." † The squeezing trucks already referred to run upon a tramway from the peat bog to the masticating machine, to be next described, being drawn from the former to the latter by convenient hoisting gear.

The *second* stage of the process, that of masticating the peat, now begins. This masticating, or cutting the peat up into very fine portions, is performed by a machine consisting "of a vertical chamber in which revolves a shaft, having fixed upon it a series of screw-like blades, the action being somewhat similar to an ordinary pug or tempering mill. The rough peat from the squeezing trucks is fed into the hopper of this chamber, and by the action of the blades is broken up and forced downwards into the comminuting apparatus. In treating stony peats, an arrangement of 'screening' may here be introduced, by which the stones are arrested and separated from the peat." * Connected with this vertical chamber, above described, into which the peat is originally cast, is a horizontal cylinder which completes the mastication and pulping. This cylinder forms the body of the machine, and is fitted with a central revolving shaft, upon which are fixed propelling screws, as also a series of curved arms or discs, so arranged upon it, that in their whole length they form a dissected double helix, with increasing spiral. Along the bottom of this cylinder, and projecting upwards towards the shaft, are arranged cutting blades of hardened steel, between which the discs pass in their revolution.

---

* Messrs Clayton's Prospectus, 1873. See also Note R.

† Ibid.

The peat thus fed into the cylinder by the joint action of the blades and screws is carried along by the discs in their forward movement, each revolution bringing the peat against the cutters, and thereby effecting a complete "masticating" process, by which the fibrous tissues and cellular structure are effectually

---

* The mining journal, "Iron," of 8th February 1873, where also fine diagrams of Clayton's machinery are given. See also the "Engineer" of 21st February 1873.

destroyed, the rooty and other undecomposed portion of the peat reduced to a state of fine pulp, and the whole mass of the peat brought into a uniform condition of homogeneity.

The peat is by these means gradually prepared, pulped, and worked forward to the delivery-end of the cylinder, whence it is expelled by the continued screw motion issuing through suitably-shaped orifices in continuous streams on to a special receiver. This consists of a number of rollers which receive the exuded streams of moulded peat; and over these the peat travels until it arrives at a point where the ends of the moulded peat-streams leave the rollers and pass on to a portable lathed tray, suitably located under the rollers to receive them, and carried on fixed wheels, of which there is a continuous forward series, so that the moving peat imparts motion to the tray, thus pushing it forward from under the rollers until the tray is filled with the moulded peat. A boy then cuts off the lengths of peat which are on the tray from the exuding mass, and places another tray in position to receive the next batch. The tray, with its charge of peat, then passes down an inclined guide or tramway in the direction of the drying sheds, and at a convenient point upon the guide the moulded peat is again cut up into the desired lengths of briquettes or blocks. The passage of the charged tray then continues down the tramway to the drying-racks, where the moulded peat upon the tray is put to dry. In about three days the peat briquettes become sufficiently dried to permit of their being taken from the portable trays and stacked in open racks of special construction, where they remain to complete the drying."*

This latter drying forms the *third* and last stage of the process. For details as to the extent and cost of the drying sheds, Messrs Clayton refer their customers to Mr William Elsam, of No. 8 Navarino Terrace, Dalston Rise, London, N.E., "whose experience," they add, "in the practical details of working peat, will greatly assist them *in arriving at the desired success.*"† On applying to Mr Elsam, he informed me that his sheds for each machine, and intended to dry 60 tons per day, cover an area of 250 feet by 100 feet, and cost, with racks complete, about £1000. In ordinary weather, they will dry the peat on an average of eighteen days during nine months in the year. They would not, however, do so in such weather as we have had during the last six months. "Of course," said Mr Elsam, "sheds cannot alter the weather. They are made of timber, with louvers all round, and opening in the roof; also with glass, so as to admit of as much light and air as possible. They are the result of many years' practical experience, and are considered by all who have seen them the best adapted to the purpose."‡

Now, as to the labour and expense required§ under

---

* "Iron," before referred to. † Messrs Clayton's Prospectus.

‡ Letter dated 13th February, 1873. See Mr Macdonell, of Morar's, opinion, p. 39, *note.*

§ See Note S, for Joint Stock Peat Company calculations.

Clayton's process. The complete machinery and plant consists of the following :—

A steam engine.

Ironwork for forming 150 feet of tramway.

Three squeezing trucks, and chains.

Macerating and moulding machine complete, with pattern of the portable trays.

Rollers and runners for forming 100 feet of delivery way into the drying sheds.

Drying sheds.

The whole cost has been estimated at L.2000 sterling; a large sum, certainly, but, as " The Colliery Guardian" of 7th February last remarks—" We must remember that the sinking of the shaft to a coal mine generally entails a cost of many thousand pounds before ever the coal is reached." If, however, the macerating machine is taken without the steam-engine (and I suppose water-power is equally applicable), then, instead of £700, it will cost £450, bringing the total cost down to £1750 instead of £2000. The macerating machine employs three men and three boys for the whole working. It is effectually operated by an 8-horse-power engine, and is capable of working up from 60 to 100 tons of moist peat per day into blocks producing (according to size) from 15,000 to 20,000 pieces of the prepared and moulded peat ready for drying. Messrs Clayton estimate that the entire cost of manufacture will not exceed 5s. per ton, which is less than the cost of manufacturing peat any where abroad, as reported on by the Dublin Commission.

I have now explained Mr Clayton's process, and given you both its mechanical and financial details. I would conclude this lengthy, but I trust not uninteresting paper, by briefly glancing at the obstacles which stand in the way of improving peat fuel, and the objections which occur to one's mind to any process, particularly when conducted under the humid atmosphere of the United Kingdom, or, I should add, the still more humid atmosphere of those elevated and undrained portions of the kingdom where the peat bogs are generally situated. I shall refer to these objections in order, and, in doing so, am greatly assisted by the remarks made by many practical men at the public meeting in the Commercial Buildings, Dublin, on 23d January 1873, at which the Report of Alderman Purdon's Commission was discussed, and a cordial vote of thanks to the commission was moved by the Lord Mayor of Dublin, seconded by Mr Adair, High Sheriff of Donegal, and adopted by acclamation.

1*st*. *Drying*.—This is admittedly the great difficulty in this country. Mr Meadows, M.E., a member of the Dublin Commission, stated that to dry peat perfectly in Ireland in the open air was "not alone an impracticability, but almost an impossibility. Peat dried in air in the most effective manner possible still retained at least 15 per cent. of moisture, and even when dried in a stove was seldom reduced beneath 7 or 8 per cent. of moisture." It will be remembered that Messrs Clayton admitted that, even after months of drying, 15 to 20 per cent. of *fixed* water would remain; and the object of their masticating or pulping machine (unknown to the Dublin Commission) was chiefly to get rid of this fixed water. Mr M'Donnell, locomotive engineer, also a member of the Commission, stated that " the only real difficulty in Ireland was that of drying. The question was one that had to be approached with the greatest care, and it was the question that was likely to militate against any scheme that was taken up. He would be sorry to say that *artificial* drying was commercially impossible, but the Commission had got very little information on that point. The space required for drying when the peat was spread on the ground was extremely large, and the expense of drying in sheds was great. (Hear, hear.) The latter expense was still greater if the sheds had to be heated by artificial means. (Hear, hear.)" I understand that no drying by artificial heat is contemplated under Mr Clayton's process ;* and I would point out that, as the Commission themselves found with regard to condensed peat, after mastication and the expulsion of both its loose and fixed water as by Clayton's process, the drying is much more quickly effected. As I have already mentioned, Messrs Clayton's sheds are expected to dry the peat in eighteen days' time, nine months of the year.

---

* As explained in the preface, the effect of artificial heat is to crack the peat, which, if air-dried, is smooth and compact. Messrs Clayton wrote me on 5th March 1873 :—" We are more and more convinced of the folly of artificial means for drying the peat, and therefore repeat that, if good, sound, and properly condensed peat blocks are required, *air-drying* by simply natural results will prove in every respect best and certainly the cheapest. If the conversion of the peat into the proposed form will not pay for ample covered space, then we say, ' Let it alone altogether.' "

2d, The next criticism to which condensed peat is exposed is, that if care is not taken in pulping the peat so as not to carry the mastication too far, the manufactured peat may actually be found to burn less readily and well than even raw and unmanufactured peat.* The Dublin Commission therefore recommended that the peat should be only roughly macerated without any separation of the fibres, and stated that they found in their examination of foreign peat-works that in no instance was the removal of the torn fibres, or any washing or filtering or precipitation of the raw peat considered necessary in the making of condensed peat.

3d, An objection has been made to condensed peat, that if a fire of it was stirred with a poker, it would go to pieces, and the peat would fall in small bits with the ashes. Mr M'Donnell, one of the Dublin Commission, said the best answer he could make to such an objection as this to stirring the peat, was "*Don't* stir it with a poker."† "There were many kinds of coal," he continued, "to which the same objection applied—anthracite, for instance, and Welsh coal, some of which latter would open like a cauliflower on being heated, and make a beautiful blaze, but if stirred would fall and choke the fire. Practice was required in the use of everything of this nature. He remembered when coke was burned in locomotives, and when they began to introduce coal, the locomotive drivers could not burn it. He believed that if coke was now again to be brought into use, they would not know how to burn it."

---

* See Mr Clayton's views, Note N.

† The peat fires at our meeting on 6th March, referred to in the preface, burned beautifully, and did not require stirring. They burned completely away to a fine white ash.

4th, Yet another criticism may be made on condensed peat, viz., that it has less calorific or heating power than coal. At the Bavarian state railways, two tons of unmanufactured peat are considered equal to one ton of coal.* Merely condensing the peat, however, does not increase its heating power. As Mr Meadows, M.E., pointed out, "If we take a ton of peat as usually obtained from our peat bogs, we find a certain quantity of heating power in it. If we take the same amount of peat (viz., one ton) and treat it so that it becomes denser, there is no more heating power in it, weight for weight, than the other. The advantage simply consists in this, that it places the material in a form much more valuable and useful for industrial and commercial purposes. (Hear, hear.)" Mr Ford North, of London, before referred to, wrote me that he considered a ton of Clayton's condensed peat must be *at least* equal to half a ton of good steam coal. As to the positive advantages and superiority of peat over coal as a heating power, I may instance the following cases:—1. In Iron smelting, as before mentioned, the best iron is smelted with peat, and not with coal.† 2. Mr Henry Anderson, junior, of Ballynacree, Ballymoney, Ireland, in a paper in the Transactions of our Highland and Agricultural Society for 1853–55, New Series, p. 186 (awarded the Society's medium gold medal), stated that he found from experience that clay pipes or tiles burnt by means of peat are of a superior quality to those burnt with the aid of coal. He strongly advocated the use of peat as a substitute for coal in tile-burning in all districts far removed from coal, and mentioned that he had seen millions of pipes and tiles, besides large quantities of bricks, burnt with peat alone. 3. Mr Le Nauze remarked at the public meeting in Dublin before mentioned, that one of the results of an experiment with peat and coal in Guinness' great Dublin brewery was, that the peat was preferred so far as the boiler was concerned.* 4. At the same meeting it was stated by Mr Norwood, on the part of Captain Ingram of the Dublin Fire Brigade, that "manufactured peat had been tried in the fire-engines when it was necessary to get up heat with rapidity; and it was found that it got up steam with greater rapidity and with less flame than hard Ayr coal, which was the best coal for getting up steam with rapidity. (Hear, hear.)"

---

* Dublin Commission Report, p. 54.

† Mr Binning Home, of Argaty, Stirlingshire (who has always taken much interest in the Peat question), told me the other day that in travelling over the Continent in a private carriage, he found that wheel-tires and horse shoes made of iron smelted in Sweden or France with peat or wood, lasted twice as long as those made of iron smelted in England with coal.

Messrs Clayton had a public test of their new condensed peat machinery at their works on 4th February last, which was attended by a large number of scientific and practical gentlemen. "The high character of the firm," wrote the "Colliery Guardian" of 7th February, "and especially of its senior partner, for practical mechanical skill in the useful arts and manufactures, as well as their indomitable perseverance and energy under adverse circumstances, drew together a larger number of gentlemen than is usual on such occasions. At the time named steam was up, and the trial commenced by passing through the machine as much wet peat as could be operated upon in two minutes, when the quantity delivered was carefully weighed, and found to be in the ratio of seventy-five tons per day of ten hours, producing when dried by their process fifteen tons of marketable fuel. This process was repeated several times. The feeling at the close of the trial was one of general satisfaction, the observers being convinced that the plan which they had witnessed was both simple and easy, and a commercial success." The mining journal "Iron," of 8th February last, also records the success of this public trial. "The results," it says, "were eminently satisfactory and convincing, and thereby is opened up an assured prospect of a successful and economical process for turning to account, as a public and private benefit, the vast stores of elementary fuel contained in bogs, hitherto an encumbrance and a detriment. The condensed dried peat becomes, as it were, an artificial coal, ignites readily, burns with a bright clear fire, and retains its red glow for a long time. In fact, by this process Messrs Clayton and Co. may claim the power to accomplish within a very short time the same, or nearly the same change as has been operated in the great laboratory and storehouse of Nature in the course of long ages, thereby forestalling or anticipating Nature's agency in the generation of coal." Messrs Clayton answered a series of questions regarding their condensed peat, which I addressed to them on 6th February last, as follows:—

---

* Major Graham, of Meiklewood, in the paper before referred to (Note Q), recommends for pumping-engines the use of "good black peat" as a substitute for coal. He mentioned that to the west and east of Meiklewood there were "on the banks of the Forth several thousands of acres" of peat; and added, that if peat fuel be used instead of coal, "the bottom of the boiler, as well as the furnace, ought to be made longer than it should otherwise be."

1*st*, We anticipate that the peat prepared by our system will be applicable *to all purposes*—household, manufacturing, metallurgy, railways, &c.

2*d*, The combustion of our peat is somewhat quicker than some kinds of coal.

3*d*, With a suitably formed furnace, our peat will generate steam more quickly than coal.*

4*th*, It will also keep up steam equal to coal.

5*th*, In an open grate it has the usual peat odour while burning,† and burns to a small residuum of white ash, with very much less debris than coal generally.

6*th*, All kinds and qualities of peat submitted to us have been equally well operated upon,‡ producing more or less specific gravity according to the natural state of the peat and the depth gotten.§

Being unable myself to accept Messrs Clayton's invitation to attend this public test, I requested Mr

---

* See Mr Norwood's evidence, p. 36.

† No odour was perceptible at our Meeting on 6th March, although Clayton's peat was burned in an open grate.

‡ See as to Huddersfield peat used, p. 39.

§ See Mr Anderson's remarks as to depth, p. 7.

Ford North to visit the works, and give me his opinion for the information of our Society. He did so, and wrote on 8th February, that provided the drying sheds are capable of thoroughly drying the peat in a reasonable time in all seasons, which Mr Clayton does not doubt, he should have no hesitation in pronouncing the operation a success. Mr North mentioned that the public trial had been attended by about sixty gentlemen, most of them scientific; that of these forty or more had entered in a book their respective opinions of what they had witnessed, and that all were expressive of high approval.

The "Times," of 13th February last, in describing a visit of the Duke of Sutherland and a select party of gentlemen to Messrs Clayton's works on 10th February, states, as its opinion, that "Messrs Clayton have seemingly perfected the mechanical means of producing condensed peat fuel on a commercial scale, and at a *minimum* and remunerative cost. The peat used in the trials was brought from Huddersfield, and was chiefly top peat of a very fibrous nature. The resulting yield, however, was perfectly homogeneous, and very satisfactory as regards quality."* The "Mining Journal," again, of 11th January last, mentioned that the "Duke of Sutherland not only sent raw peat from his own bogs, but he also visited the Atlas works to see the process of its manufacture; and he and the distinguished party who accompanied his Grace left satisfied that the conversion of peat bog into a compact, and hence portable condensed fuel was virtually a realised fact, the economical and commercial requirements of the trade being complied with—that is, the project will pay. Will Clayton's condensed peat fuel," continues the same journal, "keep down the price of coal? The obvious answer to this question must be given in the affirmative, Yes,—as it is found that the cost of thus converting peat into solid blocks of fuel does not exceed 5s. per ton. For domestic purposes we have only to maintain the fact, for example, that Clayton's patent condensed peat fuel has been tried in the drawing-room of Her Majesty, where it gave the greatest satisfaction. From the extravagantly high price of coal at the present time, the success of the invention cannot fail to procure for it a national patronage."

---

* Mr Æneas R. Macdonell, of Morar, Inverness-shire, mentioned to me lately that he had attended one of Clayton's public tests. Some of the peat used and satisfactorily condensed was so bad, that in his district they would have thrown it away. He had also inspected models of Mr Elsam's drying sheds before referred to, and considered them to be as perfect as art could possibly make them.

I have now, Gentlemen, laid before you a general summary of the great present question of Peat as a Substitute for Coal, and I have described more particularly the latest contribution to its practical solution—the process of Messrs Clayton. In the success of that system I need hardly say I have no personal interest whatever. To borrow the words of Alderman Purdon, of Dublin, in forming his recent Commission, I have had only "the practical good of our country at heart."

If I have in any way helped to make this not generally known, but most interesting and most important, subject better understood, I shall feel that my humble efforts are amply rewarded. And I would only express in conclusion, Gentlemen, the sincere hope in which, I am sure, you will all join, that, whether by Clayton's process or any other, whether now or long years after this, I say I would earnestly hope that the day may come when those vast tracts of barren ground covering so much of our country may be redeemed, and that a giant industry may one day awaken our Highlands and Islands, where too often at present—to use the words of their own poet, Professor Blackie—only

> " The wild bird whirrs o'er the mosses bleak,
> And the wild wind whistles free."

APPENDIX.

NOTE A.

Peat Soil Preventive of Potato Disease.

It has been found, I understand, both in Ayrshire and Dumfriesshire that potatoes grown in a peat moss do not take the potato disease. For culinary purposes such potatoes are not so much esteemed, but for growing them for seed, planting in peat is not uncommon.

NOTE B.

Mr Mundella on the Present Coal Famine.

Mr Mundella, M.P., in moving the House of Commons on 21st of February last for a Select Committee to inquire into the causes of the present dearness and scarcity of coal, and to report thereon to the House (which was agreed to) said:—"Sir William Armstrong was quite right in estimating that the increased cost to the country at this moment of our consumption of coal over what it was two years ago was at least £44,000,000 sterling. He believed that that amount was under the mark, and he had heard it estimated as high as the total taxation of the country. In some districts in Lancashire the amount of wages now paid per day was £1000 less than that paid a short time ago, the reduction being attributable to the scarcity and dearness of coal." The Select Committee (which has power to send for persons, papers, and records) consists of seventeen members of Parliament, viz., Messrs Mundella, W. H. Smith, Watney, Ayrton, Anderson, Carter, Corrance, J. S. Hardy, Denison, Grieve, Liddell, Pease, Pim, Potter, Vivian, Stanhope, and Wharton. It held its first meeting on 10th March 1873, and, contrary to general expectation, the Right Hon. Mr Ayrton, H.M. Chief Commissioner of Works, and not Mr Mundella, was elected chairman.

NOTE C.

Effect of the Coal Famine on Commerce and Industry.

The "Daily Telegraph" of 17th February last, remarked that "among the indirect results of the coal crisis is the stoppage, partial or entire, of industries that have far less to do with that mineral as consumers than iron. Lancashire is beginning to groan heavily under the burden now imposed, not so much because the price has been increased, as because supplies cannot be obtained at any price. Some of the cotton spinners have closed their mills wholly, and others partially, a few work only during the hours of the daylight to save gas, and so on." Writing in 1844, Dr Kane, in his "Industrial Resources of Ireland," says,—"Mr Henwood, who has calculated the total quantity of coals raised in Lancashire and their price, gives as the resulting average cost per ton 10s. 10d."! It has of late been seriously contemplated by the owners of the great lines of steam-ships between Liverpool and America, to save the coals used by lengthening the time required for the passage. Thus the want of fuel cripples our very mercantile marine, thereby promoting decadence, and barring progress and civilisation.

In the report of the directors of the Caledonian Railway Company for the half year ending 31st January 1873, they attribute the great increase in the working expenses for the past year to "the excessive rise in the price of fuel." They add, that the prices paid for coal averaged "during the half-year 6s. 7d. per ton in excess of the cost in the corresponding period of last year." They conclude by declaring a dividend of 3½ per cent. as against 5¾ per cent. for the corresponding period of the previous year.

The directors of the North British Railway Company, in their report for the same half-year, ending 31st January 1873, state that the increase in working expenses in coal alone during the half-year, "is no less than £35,395, or equal to 2⅛ per cent. per annum on the Ordinary stock of the company. If," they say, "the present extreme prices are to be maintained, the directors will have no alternative but to make further advances on the rates."

We see, then, that not only are the marine, but also the inland communications of the country seriously affected by the present Coal famine.

NOTE D.

Effect of the Coal Famine on the Public Health.

As stated in the "Times" of 13th February last, Dr Whitmore, medical officer of health for St Marylebone, reported, that the dearth of coal was seriously affecting the health of the destitute poor of the parish. I have heard that in Edinburgh some poor families have of late been subsisting on cold food alone, having been unable to afford fires. The effect of this reduction of animal heat in cold weather must be very injurious.

NOTE E.

Peat Charcoal as a Purifier of Sewage.

"Each ton of charcoal," Mr Danchell maintains, "is equal to the absorption of at least two tons of solid sewage matter, which matter is, at the same time, rendered perfectly free from smell, and harmless to men and animals. At this rate, our peat bogs may furnish charcoal for eighteen thousand millions of tons of manure." At a public meeting held in Edinburgh on 16th January last, on the subject of the purification of Scottish rivers, Mr Danchell's system was, among others, explained and remitted to a committee, Mr

Milne Home, of Milnegraden, LL.D., F.G.S., one of the Vice-Presidents of our Society, convener. See note, p. 24.

NOTE F.

An Irish Grievance in 1844.

Even then Ireland seems to have had a "grievance," for Dr Kane prefixes as a motto to his book, the following neatly turned sentence:—"Qu'est ce que fait la difference entre l'Angleterre riche et florissante, et l'Irlande pauvre et imbecile? Le savoir industriel.—*Briavionne.*" I need hardly say that this is *not* the difference. The distinction between the two countries is, that Ireland lacks self-help or self-reliance, whilst Britain has always depended solely upon her own energies. Alderman Purdon's Commission seems to me to augur a new era for Ireland, in which she shall, by private and social disinterestedness, patriotism, and enterprise, win for herself at last prosperity and peace.

NOTE G.

Observations on Peat—its Formation, Characteristics, Extent, and Use in Ireland.

Peat or turf, like coal, is a vegetable product, but unlike coal, it is light, fibrous, and spongy.

The quality of peat is very variable, but as a rule it improves in proportion to its depth below the surface, owing in part to the more perfect decomposition of the fibre, and in part to the pressure of the superincumbent mass. Deep down it is comparatively dense, and, always dark in colour; near the surface it is fibrous, and in colour of a light brown.

Peat grows higher year by year, the plants on the surface being in a state of vegetation, and consisting of reeds and grasses, heaths, mosses, and lichens. These plants, with the roots and leaves of trees, become, when decomposed, the component parts of peat. Peat fields may be divided into two classes, which, for distinction, may be named "high" and "low."

"Low" peat is formed in ponds and lakes, and in the waters of almost motionless streams; is either almost or altogether submerged, and composed mainly of reeds and aquatic grasses. Near the surface this turf generally contains a large proportion of coarse fibre, but the whole, to a depth of, in some instances, 21 or 22 feet, is free from roots of trees. These peat fields are found in most countries in the north temperate zone, and when, by continued growth, the surface emerges above ordinary water level, it is usually clothed with rich grass. By the excavation of low peat fields valuable pasture lands are converted into wastes of water, a process now going on in the valley of the Somme, &c.

The peat fields, for distinction called "high," are found above the river flats, or on mountain tops, or at lower heights in natural basins, and the growth of such "bogs," which are principally composed of mosses, is proportioned to the dampness of the site and climate, and in some instances attains a thickness of 40 feet. High peat fields are unproductive, save of heather and bog myrtle, a few stunted birches and firs in some cases dotting the surface. Unlike the "low" bogs, therefore, their removal is, in an agricultural point of view, desirable, as increasing the area of productive land.

The qualities of "high" bogs differ greatly. At various depths, and sometimes where they grew, are found roots of trees, and not unfrequently large trunks lying in a high state of preservation, owing to the antiseptic qualities arising from the presence of tannin.* Some bogs are injuriously full of small roots, while others are freer from fibre, and composed almost entirely of pure moss.

Peat, as it is cut from the bog, contains from 75 to 90 per cent. of water; in other words, to get a ton of *perfectly* dry turf, there should be raised from four to ten tons of peat, from which should be evaporated from three to nine tons of water; assuming here, for purposes of illustration, a theoretical perfection of dryness.

In practice, however, air-dried turf usually contains from 18 to 25 per cent. of water. It does not appear to be capable of being dried in air beyond a point at which it will continue to retain about 15 per cent of water. This percentage of water does not, however, much interfere with its employment as useful fuel.

---

* Men in armour, in a good state of preservation, have been dug out of the Solway peat mosses; and not many months ago a Scotch Covenanter was taken out of a Dumfriesshire one.—R. R.

Peat when dried is light, and, therefore, cumbrous in storing and removing. A cubic yard of coal in the solid condition weighs about a ton, whereas a ton of common turf will occupy from three to four times that space.

The difficulty of drying peat, and its bulkiness when dry, form the chief objections to its production and use as fuel, and the desiderata are, first, a sure and cheap method of drying, and secondly, density.

Peat of the best quality, when well dried and dense, approaches coal in specific gravity, and yields, as Sir R. Kane states in his " Industrial Resources," " a vast body of volatile inflammable ingredients—hence, for all flaming fires turf is peculiarly applicable."

Various estimates have been put forward of the relative heating powers of coal and turf—their comparative values as fuel—some rating peat at less than half the value of coal (weight for weight), others at two-thirds. These estimates *may*, in different cases, be true, for the value of peat is very variable, depending on its quality, density, and dryness, and in the combination of these no two samples may be found identical.

In Ireland are peat fields of every kind and quality, "high," and " low," moor and mountain, in extent far exceeding those of most other countries, covering almost one-seventh of its surface, or nearly three millions of acres, of which over one million and a quarter are mountain bog, and more than a million and a half occupy less elevated positions, scattered very generally over the whole island. The "low" peat fields stretch along the margins of rivers and lakes, forming good pasture lands, which it is as unnecessary as it would be injurious to convert at present into watery wastes in order to procure fuel.

Turf is the almost universal fuel of the Irish peasant: cut with a "slane," too often in clumsy, shapeless masses, and spread for drying on the undrained surface of a wet bog. When "soaked," it is "reared" in small heaps, frequently packed too closely for ventilation, and finally it is "clamped," or built into large piles.

Labour having become dear, turf-cutting is now generally deferred in Ireland till the spring farm-work is over; and thus, as in the summer of 1872, opportunity is lost, and the turf, still wet, remains in the bog, useless and unapproachable.

The "turf," when "cut and saved," is variable in form, size, and quality, and is rarely sufficiently dried. Even when it feels dry, it contains a variable percentage of water, and some of its heating power is consumed in evaporating the moisture thus retained.

A superior description is made in many of the Irish turbaries, and known variously as "hand turf," "foot turf," and "stone turf." It is generally made of black peat "pulloughed," or taken from the bottom of the bog, and "footed" into "mud," is shaped with the hand, and when dried, almost deserves the name of "stone turf;" but if the season be wet, this turf, too, is lost. In short, Irish turf, as now "saved," except in a very dry season, is at best a precarious fuel.—*Report of Dublin Commission* (*Alderman Purdon's*) *on Peat Fuel*, 1872, *Appendix C.*

NOTE H.

Effect of Coal Famine on Clyde Steamers.

These details (p. 13) are of importance to those of our steamer companies whose vessels ply where peat is contiguous and coal scarce. The "Scotsman" of 19th March last contained the following on "*The Clyde River Steamers and the High Price of Coal.*—During no recent winter has the steamboat accommodation on the Clyde been on so meagre a scale as during the last five months. Even at present there are only two departures daily, and a third boat sailing every alternate day from Glasgow. These are the 'Vivid' at twelve for Kilmun, and the 'Sultan' at two P.M. for Rothesay, daily, and the 'Carrick Castle' for Lochgoilhead, three times a week. At this period last year there were seven daily sailings and one tri-weekly sailing—viz., 'Carrick Castle' daily, for Lochgoil; 'Undine,' 'Sultan,' and 'Dunoon Castle' for Rothesay, the 'Elaine' for Millport, the 'Craigrownie' for Gareloch, and the 'Vivid' for Kilmun, with the 'Lancelot' for Millport and Arran thrice a week. There is as yet no intimation of any additions to the steamers sailing from Glasgow, excepting that the 'Carrick Castle,' on and after to-morrow, will make daily runs to Lochgoil.

The high price of coal is the cause of this state of matters, as it is stated that at the present price of coal an additional expense of from L.20 to L.30 a week is entailed on each steamer. Several of the steamboat owners are contemplating a general rise of fares this season."

NOTE I.

Effect of Coal Famine on British Iron Smelting.

With reference to the *superiority* of peat for smelting, and the desirability, if for this reason alone, of its substitution for coal, we may consider the remarks of Mr H. Vivian, M.P., in supporting Mr Mundella's motion for a select committee, before referred to: "If the present high price of coal should continue," he said, "it would be impossible for this country to maintain her position as the centre of the smelting industry of the world." For the opinion of the "Times" on Mr Mundella's motion and the coal question, see Note J.

NOTE J.

*The Debate on the Price of Coal.**

"Every one will admit that Mr Mundella's motion was well-timed. The increase in the price of coal is a national question of transcendent importance; it affects every householder who sees his winter stock shrinking, and finds that, instead of being able to replenish it at the reduced prices he confidently anticipated with the return of spring, he must buy at a price greater than he paid at the approach of winter; it affects still more painfully the man who lives on weekly wages, who has neither had capital to buy nor cellars to store the coal he needs to sustain the life of his family, and upon whom the cost of obtaining fuel in these hard days of grey easterly winds presses with unparalleled severity; but, even when we have realised most fully the position of such a wage-earner as this, we have not probed the whole influence of the increase in the price of coal. The maintenance of prices of coal such as we have been accustomed to is the condition of our supremacy as a manufacturing nation. Cheap coal is cheap labour. The latent energy of coal, stored up for unnumbered thousands of years in our subterranean treasure-houses, is the motive force of all our great manufactures. If we lose this, we are indeed forlorn. Why is it that raw cotton comes from the southern states of America to be spun into the fabrics which are exported to the East Indies, the native home of the cotton plant? Why is it that wool is brought from Australia to England to be woven into the broadcloth that is sent back to Australia in the shape of ready-made clothes? Why is it that tin from Banca, that copper from Chili and Australia, that sugar from the Antilles and the Mauritius, are poured into England in their rough and unmanufactured condition, to be smelted and refined and adapted for use by those who require them? It is not because we have an unusual supply of labour. Other countries

---

* From the "Times," of 22d February 1873.

—Ireland, for example—have ample supplies of labour; and, indeed, the reserve supplies of labour are everywhere abundant, and are always forthcoming where there are means of employing them to advantage. We have developed supplies of labour for this reason, and for this reason only,—that we have the means of setting it to work. We owe our position simply to this,—that we have got at hand the piled-up natural force in directing which human labour is most efficiently employed, that the substance in which this force is accumulated is in itself so bulky and cumbrous that it is less toilsome to bring the raw materials to it to be converted into the finished product, than to carry it to the place of production of the raw materials to manufacture them there; and it follows that if, through the diminution of our store, the basis of manufacture can no longer be obtained from our mines with the same facility as from other reserves, the homes of production will shift with the shifting cheapness of coal. The centre of gravity of the industrial world will always be found where the labour of appropriating the motive forces of nature is least. This is, at all events, the principle of migration of industry. Men cannot without some delay transport themselves in nations from one field to another, as the return they obtain for their industry varies; there is a good deal of friction impeding the migration of races; but the course of change always tends to pursue the bounty of Nature, and we can often see the ripple of the movement before the current has reached its full force.

"Mr Mundella had no theory. All he submitted to the House of Commons was that we are at present confronted with a grave danger. Coal has doubled its price. Householders are alarmed. Manufacturers are stinting their work, and deliberating upon the course it becomes them to pursue. It is well to ascertain what is the cause of this disastrous rise in the cost of the first element of our industry. Accordingly, Mr Mundella asked for a select committee to inquire into the reasons of the present dearness and scarcity of coal. Nobody had a word to say against the motion, and the Government, through Mr. Bruce, assented to it; and, indeed, it could do no less. There are three theories to account for the present exaggerated price. The first—the most pleasant—is that it is due to causes which are, for the most part, accidental and temporary, and that it has been aggravated by panic. Men who know what their wants will be during the next three months, and see prices rising, are rushing to coal-dealers to secure supplies, and their competition forces the market up beyond all reason. Mr Mundella mentioned some facts which countenance this view. He referred to a colliery where the labour-cost of raising a ton of coal eighteen months since was 2s. 6½d., and the price in London was 18s. to 20s. The labour-cost is now 3s. 2½d., and the price in London is 45s. to 50s. This is instructive, because it shows that the increased price of coal is not due to the increased wages of labour; but we must not jump to the conclusion that, because the labour-cost of a ton of coal in a particular colliery has not materially risen, the advance in its price is factitious and permanently untenable. The demand may have so risen on the supply that colliery-workers have been forced to resort to mines where the labour-cost of raising a ton is double what it was in the least productive mines of two years since, although the cost in Mr Mundella's colliery has not risen more than 26 per cent.; and the market price will be ruled by the least productive collieries, the additional profit in Mr Mundella's example going to the lessees during their leases, and to the mine-owner ultimately. On the other hand, it is conceivable that panic has been the main element in the rise of prices, and that middlemen have been driven, without any fault of theirs, to protect themselves from the competition of purchasers by doubling their quotations. A second theory refers everything to the depreciation in the value of gold. Here, again, a plausible argument can be offered. Gold has declined in value, but in different proportions with respect to different commodities. The fall first appeared in the matter of beef and mutton, and other agricultural products; next it passed into manufactured articles; next into the implements of manufacture, iron, &c.; now it is passing to the motive force of manufactories. Supposing this to be the truth, it would explain the theories of Mr Liddell and Mr Bruce. Trade has been brisk, said Mr Liddell; there has been great prosperity in the iron trade, and other trades using coal, said Mr Bruce; but why has there been this briskness and this prosperity? If it be because the movement of prices becomes perceptible in different forms of industry after different intervals of time, according to their dependence upon special classes of consumers, foreign or colonial, or any other diversity of causes, the whole thing is explained. Such things have been, and such things may be again. We know that in the sixteenth and seventeenth centuries society was disturbed, and in some measure disorganised, throughout Europe because certain classes—kings particularly—found the customary payments upon which they depended to be diminishing in efficiency, and resorted to irregular methods of increasing them. It may be that textile manufacturers have found the prices of their goods rising, and have pressed upon machine makers and ironworkers, and these are now in their turn pressing upon coal producers. Supposing this were the real explanation of our position, we should have to confess that we were passing through an unpleasant, but still a terminable crisis. Prices might ultimately be double what they have been, but they would at length arrive at a position of equilibrium. There is a third theory—subdivisible, however, into two. The first suggests that we are feeling the beginning of the end of our peculiar resources; the second—it is unfolded with great vigour in a letter from Mr John Ball, which we publish elsewhere—is that, not we only, but all the world, are being warned of the exhaustion of the stored-up force that coal puts at our disposal."

The complicated state, alluded to in this article, of the modern relations between Capital and Labour, culminating in combinations, strikes, &c., must be taken into account by capitalists in regard to working peat in competition with coal. Peat-bogs are not generally situated near great centres of labour, and hence their clearance for fuel will not (at least for some time) be subject to the present complications of the Coal market. Peat will be best worked in remote districts, where wages are not high and strikes unusual, and where its working will prove an unexpected source of wealth to a formerly poor population. Thus the now great shale oil industry to the west of Edinburgh, commenced only a few years ago by Mr James Young, at once found a ready labour-market, and conferred upon a poor district a lasting benefit.

NOTE K.

System of Mr Box, C.E.

I have been unable to discover the address of Mr Box, or to obtain a copy of his pamphlet. He is not "Mr Box, consulting engineer," in London Directory; and he is not known to the secretary of the Institution of Civil Engineers, London. Alderman Purdon, of Dublin, wrote me on 5th March last,—" The Mr Box you refer to is an English engineer, who, I believe, has had experience in peat machinery, but his machines are not yet made,—I mean the recent one recommended by him. It is, I believe, to be a modification of Carr's disintegrator, working in water to wash the fibre out of the peat. It is a very expensive process."

NOTE L.

Importance of Peat Charcoal.

The Rev. Patrick Bell remarked in a paper in our Highland Society's Transactions, vol. iv. New Series, 1835, p. 151: "We believe that the charcoal of *compressed* peat has not yet been submitted to the test of experiment. The subject is of some importance, and the individual who would conduct a series of experiments to determine its value, would confer a benefit on the country." Mr Danchell here (p. 18) furnishes this desideratum, and is therefore entitled to this praise. In the appendix to their report, the Dublin Commission (Alderman Purdon's), on peat-fuel (p. 43), say,—"Peat carbonised is one of the best charcoals made. Being free from sulphur, the quality of iron manufactured with it is of a very superior class; and at Horwich in Lancashire, Mr Alsing, the very intelligent local superintendent of the 'Peat Engineering and Sewage Filtration Company,' showed us a building which an independent company was erecting alongside his company's ovens, for the manufacture, with peat charcoal, of steel of superior quality." Mr Andrew Steel, of Crosswoodhill, in his excellent "Natural and Agricultural History of Peat Moss or Turf Bog," published by Mr Adam Black, Edinburgh, in 1826, states (p. 33)—"Firm peat is very easily charred by smothered combustion, even in an ordinary chimney-grate, as is generally done in Holland, where its charcoal is commonly used in winter for burning in small pots, for the purpose of keeping the feet warm. We are informed by Mr Headrick, in his Essay, printed in the Communications to the Board of Agriculture in 1800, that some of the Scotch Highlanders convert large quantities of black peat into charcoal, which the smiths use in their forges ;* and he thinks this species of fuel is better adapted for the reduction of metal and the making of bar-iron than even charcoal of wood. The 'Stutgard Physico-Economical Essays, 1763,' state also that turf-charcoal burns more clearly, and gives a more equal and constant heat than wood-charcoal, and that the heat by it can be raised to the greatest possible pitch of fervency; and bar-iron is sometimes made by means of peat fuel in certain districts of Germany and in France."

NOTE M.

Irish Compressed Peat Company.

I am not aware whether this is the company of which Mr James Kerr, of Edinburgh, writes on 8th February last :—"It was only the recent cheapness of coal that hindered the success of the Irish Compressed Peat Company, now about to resume operations, with every chance of benefitting themselves and the nation at large."

---

* Mr Macdonell, of Morar, tells me that this practice has died out, at least in his district of Inverness-shire. Considering the advantages of peat-smelted iron, this is to be regretted.

NOTE N.

Old Experiments and Inventions of Members of Highland and Agricultural Society.

The description of a "Machine for Compressing Peat Moss, invented by Lord Willoughby d'Eresby," is given in the Prize Essays and Transactions of the Society, vol. v., New Series, 1837, p. 458. It begins,—"The important subject of determining the best and most economical means of rendering peat fuel more effective for domestic and manufacturing purposes, has of late excited the attention of many individuals." His Lordship invented a machine (figured in Transactions) for compressing peat, and to be worked with the hand. He did not, however, consider it perfect, and was still studying its improvement. More than five years before this, in vol. iii., New Series, 1832, p. 373, Mr Walter Tod, Longhope, near Hawick, described a primitive wooden appliance (figured) for compressing peat. He also furnished statistics, showing that, in competition with Vogrie coal, compressed peat of equal weight (137 oz.) raised the temperature of a room several degrees higher than the coal. He also mentioned that if, previous to being compressed, peat is "put into an iron trough and wrought into a consistency like paste," the peat would not only (1), even if originally of a light brown colour, become black, showing "that some chemical action takes place by the minute particles of the moss being exposed to the air," but also (2) the heat afforded would be greater, and (3) the light would be much more clear and beautiful. The advantages of "condensed" peat were thus early recognised in Scotland. The interest excited by Mr Tod's paper led to the production by Mr Slight, curator of the Society's Museum, of a much more elaborate "peat pressing machine," described and figured in vol. iv. of New Series, 1835, p. 111. The model of it was submitted to the Society in November 1832, and a premium was awarded by the committee on Machinery.

Messrs Clayton wrote me on 5th March 1873, "Our senior was personally engaged for the Lord Willoughby d'Eresby, of that date (1835 to 1837), making experiments for him, and arranging his machinery for *compressing* peat; and it was our senior who introduced *hair-cloth* as lining to the moulds, to prevent the escape of the pulpous portion of the peat as described in his Lordship's patent. Also, after completing these experiments, and proving to himself that compression was impossible and a theoretical fallacy, he advised his Lordship to try the separation of the fibre and rooty portion from the pulp or decomposed portion, which he succeeded in doing most effectually; but the result of such proved he had done *too much*, as the peat so prepared dried as hard as marble and would not burn.

"These and other experiments subsequently made by our senior convinced him that all such means were practically wrong, and induced him to have recourse to cutting up or mincing the whole mass, which has proved beyond doubt the right means to the long-desired end."

NOTE O.

Instance of Export of British Coal.

As an instance of only one month's export of British coal by only one railway company from one port, take the quantity shipped by the Manchester, Sheffield, and Lincolnshire Railway Company, from the port of Grimsby during December last. The following are the figures :—

		Tons.
Shipped to	Belgium, . . .	711
„	Denmark, . . .	326
„	Egypt, . . .	3940
„	France, . . .	9574
„	Germany, . . .	3399
„	Holland, . . .	528
„	Italy, . . .	386
„	Norway, . . .	447
„	Prussia, . . .	499
„	Russia, . . .	997
„	Sweden, . . .	768
„	Spain, . . .	239
	Total, . . .	21,814 Tons.

Against 20,014 tons shipped abroad in December 1871.

It has been seriously proposed by some, that an Export duty should be laid upon coal, a proposal made many years ago by the present Premier, Mr Gladstone. The total exports of coal for the United Kingdom have been increasing at the rate of a million tons per annum, being for 1870 eleven, 1871 twelve, and for 1872 thirteen millions of tons. 800,000 tons of coal were exported in both January and December 1872, but the declared value of this amount in January was L.400,000, whilst it had risen in December to L.800,000.

NOTE P.

Mr Ford North's Views on the Improvement of Peat Fuel.

In a letter to me, dated 3d February last, Mr Ford North, previous to having seen or heard of Messrs Clayton's process (his subsequent opinion of which will be found at page 39), favoured me with his views on peat as a substitute for coal, as follows :—

"I have visited many of the principal bogs in Ireland and some in France, and I have, through Mr Danchell's kindness, been permitted to spend some time at his works at Horwich, and have made a good many calculations as to cost, &c., &c., from all which I come to the following conclusions, viz. :—

"1. That there is but one real difficulty in manufacturing from peat a very valuable fuel, viz., *the drying.**

"2. That to attempt to accomplish this *in the open air* in such a climate as ours, would be to incur *certain failure.*

"3. That even the drying in sheds would be very uncertain, particularly in so moist a climate as Ireland or Scotland, unless you could introduce strong blasts or currents of air by machinery to expedite the process.

---

* See Mr M'Donnell's opinion, p. 33.

"4. That artificial drying by steam or hot air could only be applied when the peat is compressed by machinery, from its liability to crumble into very small particles.

"5. That the use of these artificial means would so enhance the cost of manufacture, as to preclude all idea of profit so long as coal remained at anything like a reasonable price. If, however, present prices of coal are to be maintained, or to go even higher, of course a margin will be opened for the introduction of *artificial* means of preparing peat.

"A very advantageous application of peat is its conversion into charcoal, in which state it becomes most valuable for the smelting of the best iron, for sugar refining, and a variety of other purposes, and, above all, for most important sanitary uses, to which end, as you are probably aware, Mr Danchell is so largely employing it."

I would take this opportunity of thanking Mr Ford North for so kindly furnishing me with the above most interesting and instructive particulars.

NOTE Q.

Major Graham, of Meiklewood, on the Removal of Peat Moss.

Major Graham, of Meiklewood, parish of Kincardine, Perthshire, gives, in vol. iii., New Series, 1832, p. 223, of our "Highland and Agricultural Society's Prize Essays and Transactions," an "Account of the improvement of 130 acres of land covered by peat to the depth of 10 feet," which was awarded the Society's gold medal. Talking of the labourers necessary, the Major humorously observes,—"The men should all, if possible, be worked against each other. I found this to expedite the work amazingly. At one time half of the men were Irish, the other half Scots. When the strife of rivalry commenced, heroic deeds were achieved, and I thought my heroes were much better employed than others of more renown, for mine were making food for men, while they were making men food for worms." Referring to the peat moss, he says,—"The existence of so ugly an object in the midst of my property was exceedingly disagreeable." The cost of clearing 100 acres of peat averaging 10 feet deep came to L.3290, 4s.; but Major Graham adds, "I wish I had a thousand acres more of it, and I should soon have enough cleared to pay the expense of the remainder." The peat was removed or "floated" by the agency of water pumped by steam-power from the river Forth, being the first known use of steam for such a purpose. See *note* at page 36.

NOTE R.

Coal-Peat as Fuel, by P. Maccallum, C.E.

"DUNFERMLINE, *5th March* 1873.

"Hitherto, most attempts to produce peat fuel, fit for general use, on a commercially remunerative scale, have failed, principally in consequence of the great quantity of water which the native peat contains. This excessive moisture has often been tried to be got rid of, but in most instances this required an expenditure in fuel which neutralised any advantage that might otherwise have been obtained. The great bulk of the water in peat is principally held in the fibrous and cellular tissues, and can only be got rid of by close trituration or mastication. Pressure, however applied, will not effectively dispel this water, it being chiefly confined in the tough vegetable fibre; and the only way in which the water can be released is by reducing the whole to a pulpy mud or homogeneous mass by passing it through crushing or masticating machinery. After this process, the mere hydroscopic or free water readily evaporates: and peat, when thus treated, becomes very cohesive, and is an excellent medium for retaining and utilising pulverised coal waste or dust. The peat readily absorbs and fixes a quantity of coal dust equal to its own bulk, and when properly mixed and dried, it becomes quite hard and firm, and forms a very excellent fuel, especially when a little gas-work pitch is added to make up for the natural deficiency of bituminous matter in the peat. Of itself, peat is too light for being burned in furnaces where there is any blast; but when it is mixed with coal waste and gas pitch, in proper proportions, there results a fuel not inferior to the best coal for producing caloric.

"This composition is easily dried by artificial or natural means; it then kindles readily, and is very inflammable. When burning, it cakes into a hard incandescent mass, and gives great heat, and when consumed the ash residue is very small, being somewhat under. four per cent. The fuel dries quickly, as the moisture evaporates very freely after the peat fibres are broken up ; and when the water is once dispelled, it has no affinity for it afterwards, as the fibres, which would again absorb by capillary attraction, are entirely destroyed in the process of trituration. Peat is of various qualities. Near the surface it is generally light coloured, spongy, and containing the vegetable matter but little altered. At some depth it is generally brown, denser, and in a more advanced stage of decomposition. Very old peat is black, nearly as dense as coal, and much resembles it in chemical composition, the ultimate elements being essentially those of wood and coal—viz., carbon, nitrogen, hydrogen, and oxygen. Fibrous or young peat, after being properly triturated, presents much the same appearance and consistency as thoroughly decomposed peat, as the whole roots and fibres are crushed into mud. The principal difficulty in utilising peat as a fuel has always been the getting rid of the hydroscopic and fixed waters it contains in its natural state. This can only be accomplished by thoroughly breaking up the cellular tissues of the peat, and reducing the whole to a pulpy mud, after which it readily dries and becomes very dense and hard, and of nearly the same specific gravity as ordinary coal.

"Messrs Clayton, Son, and Howlett, of the Atlas

Works, London, have recently constructed and patented machinery, admirably adapted for manufacturing this composition, in commercial quantity. The fuel now exhibited was made by their machinery on Thursday last from peat sent from Fifeshire. This machine mixes and manufactures the composition in a manner that could not be excelled, and is capable of turning out nearly a hundred tons per day. The ingredients —peat, coal waste, and ground pitch—are filled into a hopper, and the trituration and mastication is effected by a vertical shaft, revolving in an upright cylinder, which carries a series of cutting blades, by the action of which the composition is forced down into a horizontally placed cylinder. Within this cylinder a revolving shaft is placed, on which a forcing screw and set of discs act, and at the end of the cylinder, farthest from the hopper, are fitted cutting blades of hard steel, and the composition is forced into the horizontal cylinder by the joint action of the blades and screw, and is then pressed forward by the twisting movements of the discs. Every revolution drives it against the cutting blades, whereby the most complete trituration is effected of the fibrous and other undecomposed parts, and the whole is thus reduced to a pulpy homogenous mass, and forced out through several orifices at the delivery end of the cylinder—of any section that may be found most suitable—after which it is cut into shorter lengths or briquettes, and removed to the drying sheds, where a few days suffice to render it sufficiently dry for use.

"It is unnecessary to enlarge on the importance of utilising the immense deposits of fuel contained in the peat fields of Great Britain, or the waste substance here proposed to be combined therewith. Millions of acres are covered with peat, and its removal would render the soil in many parts productive and fertile. In most places where peat abound, coal 'coom' or waste may be had in inexhaustible quantities. This, in its present existing state, is useless as a fuel; but though coal dust is almost incombustible as such, it is equal to the same bulk of whole coal when baked up in peat mould, as a heat-producing agent. Considering the present price of mineral fuel, a more opportune time could not arrive for the utilisation of such substances as peat mould, coal waste, and gas pitch —three ingredients of little use in their separate conditions, but which, combined, form a fuel inferior only to coal itself."

Mr Maccallum stated at the meeting, on 6th March last, that "the coal-peat fuel he had shown could be produced near Dunfermline, and sent into and sold in Edinburgh at about 8s. or 9s. a ton" ("Daily Review," 8th March.) As proved in the fire at the meeting, the coal-peat burns with great heat and a strong flame; indeed, it is fully more combustible than Clayton's patent condensed peat. It is also, from the presence of the coal and pitch which it contains, much heavier, and soils the fingers when handled. Mr Cadell of Grange, chairman of the meeting, mentioned that ironstone dust could be mixed with the peat as advantageously as coal dust.

I understand that Mr E. V. Gardiner is lecturing at present in the London Polytechnic " On Fuel—What shall we burn ? " and recommends the simple solidifying of coal dust, of which he states twenty-four millions of tons are annually wasted. The coal dust is made by him, in presence of his audiences, into solid lumps impervious to water, by means of a fluid he has invented called " the diamond fuel cement." The process takes only a few minutes, and the cost is estimated at 3s. per ton. Another method is recommended by the " Worcester Chronicle," viz., to make " coal earth balls," by mixing coal dust with an equal quantity of clay or common mud. Of course, the objections to coal dust are—1. That in some places (*e.g.*, Ireland and the Highlands) it is not to be had ; and, 2. That in coal dust districts the labour market is subject to the very complications which have caused the present high prices and scarcity of coal, and to avoid which the working of peat in remote districts was advocated at the conclusion of Note J.

NOTE S.

Proposed Joint-Stock Peat Companies and Estimated Cost of Working.

Since our meeting of 6th March last, I have been informed that negotiations are on foot for the object of forming a joint-stock company to produce " coal-peat " at Dunfermline, Fifeshire, after Mr Maccallum's method, described in note R. There seem to be unusual facilities there for obtaining both coal-waste and peat.

Messrs Clayton kindly sent me on 22d March, for insertion in this volume, the following details of the cost of working their system, as estimated and published by the projected "Dumfries Peat-Fuel Company, Limited," on 10th March last:—

DUMFRIES PEAT-FUEL COMPANY, LIMITED,

10TH MARCH 1873.

Plant for 10 *Sets of Machinery.*

Machinery and iron work complete (*vide* Clayton)	L.7,000
Patent licence	1,000
10 sheds to contain 18 days' work of 10 sets of machinery, each 300 feet by 100 feet	6,000
30,000 trays at 1s. each	1,500
2500 feet roller tramway, complete	500
Racks for trays	750
„ drying, 1000 racks, 30 feet long by 3½ feet wide	2,500
Total cost of plant for 10 sets	L.19,250

Income from 10 *Sets of Machinery.*

600 tons *minimum* production per day, equal to 120 tons *minimum* dried peat per day, equal to 37,560 tons annually (313 days), @ 8s. per ton . . . L.15,024

Income from 10 *Sets of Machinery.*

600 tons *minimum* production per day, equal to 120 tons. (See above.)

Note.—The *maximum* production is 1000 tons, equal to 200 tons *minimum* dried peat, equal to 62,600 tons annually (313 days), @ 8s. per ton, is L.25,040 or L.10,016 extra income from same machinery.

Expenditure for 10 *Sets of Machinery.*

30 men, digging 600 tons per day, 1 yard square, equal to 1 ton, @ 2d. per ton		L.5	5	0
10 men for trains	@ 3s. 4d. per day	1	13	4
10 men for machines	@ 3s. 4d. „	1	13	4
20 girls or boys for trays	@ 1s. 3d. „	1	5	0
40 men for drying	@ 3s. 4d. „	6	13	4
40 boys „	@ 1s. 3d. „	2	10	0
Foreman	@ 5s. 0d. „	0	5	0
5 engines' fuel	@ 5s. 0d. „	1	5	0
Wear and tear	@ 20s. 0d. „	1	0	0
Incidentals	@ 20s. 0d. „	1	0	0
5 engine drivers	@ 3s. 4d. „	0	16	8
Cost of 120 tons per day, equal to 3s. 10¼d. per ton, reckoned at highest cost of labour		L.23	6	8

Income for 10 sets of machinery				L.15,024	0	0
Annual production, 37,560 tons, @ 3s. 10¼d. per ton	L.7277	0	0			
Annual lordship, 37,560 tons, @ 4d. per ton	626	0	0			
Salaries and other expenses	500	0	0			
Total expenditure on 10 Sets production, equal to 4s. 5¾d. per ton, real cost of production				8,403	0	0
Nett annual profit				L.6,621	0	0

After selling peat at 8s. 2d. less than ordinary price of coal, and 17s. less than present price of coal, L.6621 is clear profit, and goes for formation of reserve fund and division as dividend.

Suppose 40,000 L.1 shares are issued, and 10s. paid up gives a capital of L.20,000, a dividend of 30 per cent. would be payable thereon, with L.621 left for a reserve fund, equal to about 3¼ per cent. on cost of plant.

40,000 L.1 shares gives, when half paid up, a capital of	L.20,000	0	0
Cost of 10 sets of plant complete is	19,250	0	0
Leaves L.750 of a balance to meet wages and expenses, till there is a realisation on produce .	L.750	0	0

(Signed) Robert C. Templeton, *Int. Secy.*

4 Chapel Street, Dumfries.

NOTE T.

Coal used in Iron Smelting.

When examined by the Select Committee of the House of Commons on Coal on 24th March last, Mr R. Meade, assistant-keeper of the "Mining Records," stated that the largest consumption of coal in this country was by the pig-iron manufacturers. He gave the following statistics of the quantity used:—

	In the manufacture of pig iron. *Tons of Coal.*	In conversion of pig iron into bar iron. *Tons of Coal.*
In the year 1867	14,283,000	14,049,000
" 1868	14,910,618	14,790,000
" 1869	16,337,000	15,859,000
" 1870	17,890,000	17,464,000
" 1871	19,881,000	18,658,000
" 1872	21,100,000	18,990,000

Truly, here would be a great field for the introduction of peat-fuel, particularly considering its superiority over coal in the special case of iron smelting. Dr Percy, in his "Metallurgy" (volume on Fuel, &c., p. 144), states that the introduction of coke into England arose from the charcoal there becoming so dear, "especially on

0

account of the increasing consumption of it in *iron-works*," and quotes the following lines, written in 1633:—

> " The yron Mills are excellent for that;
> I have a patent draune to that effect;
> If they goe up, doune goes the goodly trees.
> I'le make them search the earth to find new fire."

" The qua
pig iron m
calcined i
8 cwts. are
pipes; and
Chambers's
same artic
Ulverstone
land, are st
when this

PRINTED BY NEILL AND COMPANY EDINBURGH.

0

account of the increasing consumption of it in *iron-works*," and quotes the following lines, written in 1633:—

> "The yron Mills are excellent for that;
> I have a patent draune to that effect;
> If they goe up, doune goes the goodly trees.
> I'le make them search the earth to find new fire."

"The quantity of materials necessary to yield a ton of pig iron may be taken roundly as follows: 2 tons of calcined ironstone; 2 *tons of coal*, of which about 8 cwts. are required for the blowing-engine and hot-air pipes; and from 12 to 16 cwts. of broken limestone." *Chambers's Encyclopædia*, 1863, article "Iron." The same article states,—"A solitary charcoal furnace at Ulverstone in England, and another at Lorn in Scotland, are still working—the only relics of times past, when this was the only fuel employed."

PRINTED BY NEILL AND COMPANY EDINBURGH.

Edited by the late James Richardson, F.R.S.E.,
and Ralph Richardson, W.S.

THE GENTLE SHEPHERD,

By ALLAN RAMSAY.

In a neat case, with many beautiful Steel Etchings, and a Photograph of the Ramsay Monument, Edinburgh.

Fourth Thousand. Price 2s. 6d.

"Ramsay excels all the Pastoral Poets that ever wrote."
Lord Woodhouselee.

EDINBURGH: ADAM AND CHARLES BLACK.